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ABSTRACT

Proceedings of the 1983 CAUSE National Conference on information resources are presented. Brief notes are included on the general sessions and the special interest sessions. Forty-one conference papers are divided into the following topics: issues in higher education, managing the information systems resources, technology and techniques, small college information systems, innovative applications, and approaches to office technology. A section on microcomputers on the campus and policy issues is included, with attention to four institutions: Clemson University, Miami-Dade Community College, Oberlin College, and Virginia Tech. Information on 14 vendors is also included. (SW)

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CAUSE

Information Resources And The Individual

Proceedings of the 1983 CAUSE National Conference

HE 017 245

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December 11-14, 1983
San Francisco, California

INFORMATION RESOURCES
AND THE INDIVIDUAL

Proceedings of the
1983 CAUSE National Conference

December 1983
San Francisco, California

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CAUSE, the Professional Association for Development, Use and Management of Information Systems in Higher Education, helps member institutions strengthen their management capabilities through improved information systems.

Formerly known as the College and University Systems Exchange, CAUSE first organized as a volunteer association in 1962 and incorporated in 1971 with 25 charter member institutions. That same year the CAUSE National Office opened in Boulder, Colorado with a professional staff to serve the membership. Today the association includes 1,600 members on 650 campuses representing 450 colleges and universities and eighteen sustaining member companies.

CAUSE provides member institutions with many services to increase the effectiveness of their administrative information systems, including: the Administrative Systems Query (ASQ), which provides information from a data base of member institution profiles; the CAUSE Exchange Library, a clearinghouse for documents and systems made available by members through CAUSE; an Information Request Service to locate specific systems or information; consulting services to review AIS organization and management plans; association publications, including a bi-monthly newsletter, a bi-monthly professional magazine, and the CAUSE monograph series; cooperative workshops with other higher education associations and member campuses; and the CAUSE National Conference.

We encourage you to use CAUSE to complement your individual efforts at strengthening your organization's management capabilities through improved information systems.

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San Francisco, California December 11-14, 1983

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INTRODUCTION

The CAUSE 83 theme, "Information Resources and the Individual," focused attention on the growing complexity of the information systems environment in higher education and the impact of this complexity on the individuals who manage and use the information systems. The separate Conference tracks provided opportunities for exploration of the theme in more detail: Track I--Issues in Higher Education; Track II--Managing the Information Systems Resource; Track III--Technology and Techniques; Track IV--Small College Information Systems; Track V--Innovative Applications; Track VI--Approaches to Office Technology. CAUSE 83 attracted 535 professionals, the largest attendance ever at a CAUSE National Conference.

In addition to the 42 papers in the main tracks, 11 presentations were made in the special Vendor Track, and 13 sustaining member companies sponsored suite exhibits. A number of special interest sessions encouraged conferees to share experiences and ideas on subjects of particular interest.

A special Preview of CAUSE 83 and Overview of CAUSE, conducted by CAUSE Executive Director Charles R. Thomas and CAUSE 83 Vice Chair Joseph A. Catrambone, preceded the CAUSE Annual Business Meeting, which was held the first morning of the Conference.

The CAUSE National Conference is an excellent forum for the exchange of ideas, systems, and experiences among the many speakers and participants. We hope you will benefit from your participation at CAUSE 83 by becoming more effective in the development, use, and management of information systems at your institution. We also hope these Proceedings will provide a continuing reference throughout the year to the many activities of the Conference and of the CAUSE association.

Gary

Gary D. Devine
CAUSE 83 Chair

ACKNOWLEDGMENTS

The success of the CAUSE National Conference is due entirely to the contributions of people and supporting organizations. Although it is impossible to identify all of those people who contributed time and effort to the planning and operation of the 1983 Conference, several individuals and organizations deserve special mention.

The Program Committee, with the CAUSE Staff, spent many hours to produce an effective and smoothly run conference. Their enthusiasm, efforts, and the support of their institutions are gratefully acknowledged.

The logistics of conference registration were efficiently supervised by Jane Knight of the CAUSE Staff with the assistance of Lynda Denham

1983 CAUSE NATIONAL CONFERENCE PROGRAM COMITTEE

Seated from left to right: Jane Knight, CAUSE; Cynthia K. Chandler, Texas Tech University; Deborah K. Smith, CAUSE; Sally Campbell, Peat, Marwick, Mitchell & Co.; and Julia A. Rudy, CAUSE. Standing from left to right: CAUSE 83 Chair Gary D. Devine, University of Colorado; Dana S. van Hoesen, CAUSE; Earl A. Nienhuis, University of Illinois; Cedric S. Bennett, Stanford University; Jack K. Steingraber, Washington State University; CAUSE 83 Vice Chair Joseph A. Catrambone, Loyola University of Chicago; Charles R. Thomas, CAUSE; and Herbert W. Bomzer, Central Michigan University. Missing from picture: Charlotte McGhee, John Grenzebach & Associates.

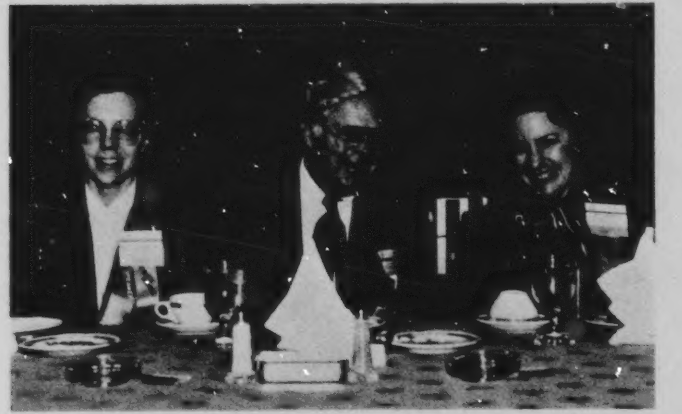
and Linda Williams of Stanford University. Their efforts, friendly smiles, and helpful attitudes were appreciated.

A special note of thanks is especially due to Julia A. Rudy and Deborah K. Smith of the CAUSE Staff for their untiring and always professional efforts. From the advance preparation which begins over a year before the conference through publication of the Proceedings, their special expertise and dedication are deeply appreciated.

We would also like to thank those member companies who sponsored suite exhibits, refreshment breaks, the Registration Reception, and the Conference banquet, and who participated in the Vendor Track.

1983 CAUSE BOARD OF DIRECTORS
Seated from left to right: Charles R. Thomas, CAUSE; William E. Walden, University of New Mexico; Dorothy J. Hopkin, Michigan State University; and John A. Monnier, University of Arizona. Standing from left to right: James I. Penrod, Pepperdine University; A. Wayne Donald, Virginia Tech; Charles H. Naginey, Pennsylvania State University; Martin B. Solomon, Ohio State University and James L. Strom, Clemson University. Missing from picture: Ronald J. Langley, California State University/Long Beach and Robert J. Sanders, Community College of Denver.

The continuing support of the CAUSE Board of Directors and the membership they represent is also gratefully acknowledged. Retiring from the 1983 CAUSE Board are Ronald J. Langley, University of California/Long Beach; Robert J. Sanders, Community College of Denver; and William E. Walden, University of New Mexico. CAUSE members elected to three-year terms on the Board of Directors beginning in 1984 are shown below. Seated left to right: Kathlyn E. Doty, Loyola University of Chicago; William Mack Usher, Oklahoma State University; and Sandra Dennhardt, University of Illinois.



The association is supported by a number of member committees which are increasingly creative and active. We appreciate the contribution of time and effort made by the volunteers who carry out the duties of these committees. At the CAUSE Annual Meeting, Vice President Bill Walden expressed appreciation to many such individuals. For their service in 1983 on the CAUSE Election Committee: Charles A. Brooks, South Carolina Commission on Higher Education; Robert L. Bray, Texas Tech University; Louis T. Kent, Radford University; Robert W. Kuntz, University of California; Shirley Roddenberry, State University of Florida; and Terrence E. Wold, University of New Mexico. For their three-year service on the CAUSE Recognition Committee: Harry Grothjahn, University of Georgia; and Charles H. Naginey, Pennsylvania State University. For their three-year service on the CAUSE Current Issues Committee: Vinod Chachra, Virginia Tech; and Paul J. Plourde, Bentley College. Special thanks are also due to Sandra Dennhardt and Kate Doty, who resigned as chairs of the Editorial Committee and Current Issues Committee, respectively, to assume their new responsibilities on the CAUSE Board of Directors.

GENERAL SESSIONS

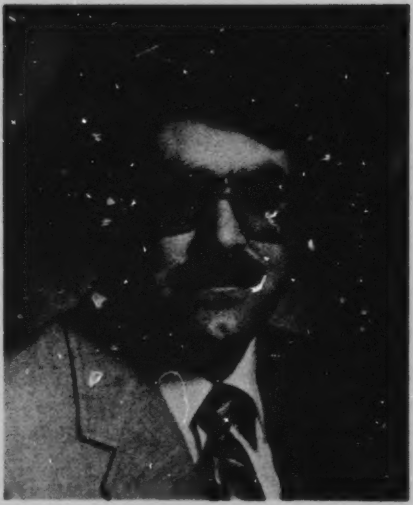
CAUSE 83 was highlighted by a number of special General Sessions which brought conferees together periodically throughout the Conference to hear presentations on subjects of broad interest and concern to all. This year the CAUSE Annual Business Meeting was held the first morning of the Conference and included an entertaining and informative color-graphics/slide presentation entitled, "CAUSE Today and Tomorrow." At the first-day luncheon, the CAUSE 83 Program Committee and the Board of Directors were acknowledged for their support during the year. The Fourth Annual CAUSE Awards Luncheon was held on the second day of the Conference and the recipients of the CAUSE Recognition Awards and CAUSE/EFFECT Contributor of the Year Award were honored.

KEYNOTE ADDRESS

PEOPLE, POWER, AND PERSONAL COMPUTERS

KEYNOTE ADDRESS

Dr. Jerry W. Willis, Director of the Educational Computing Center at Texas Tech University, gave a dynamic, thought-provoking, and entertaining presentation. "People, Power, and Personal Computers" described the revolutionary changes in our society today and explained how small computers will give people power in an economic, social, political, and informational sense. He also described the current context and approached the future from a historical, psychological, and social perspective. Dr. Willis is best known for his popular books on small computers: *Peanut Butter and Jelly Guide to Computers; Nailing Jelly to a Tree; Computers for People;* and *Computers for Everybody.*



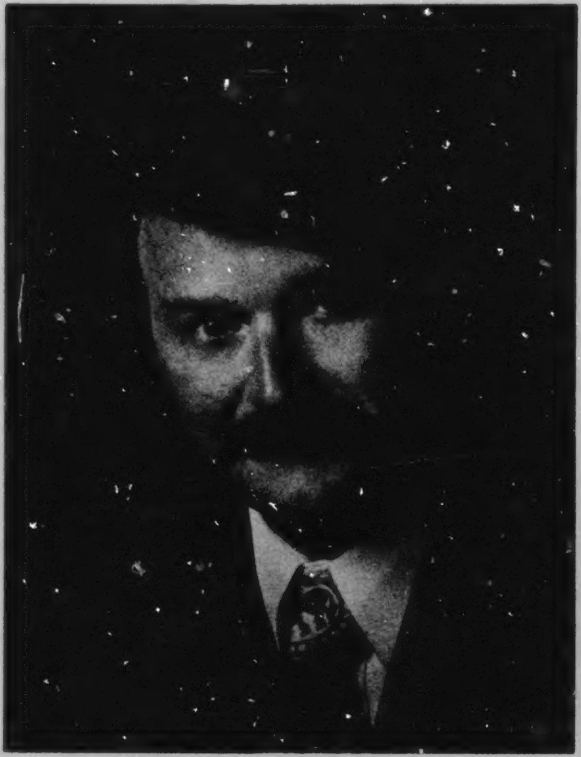
Jerry W. Willis
Director, Educational Computing Center
Texas Tech University

THE CAMPUS AND THE MICROCOMPUTER REVOLUTION

TUESDAY MORNING ADDRESS

Featured speaker J. Victor Baldridge, Director of the Microcomputer Institute at the University of California/Los Angeles, and Senior Research Sociologist for the UCLA Higher Education Research Institute, provided stimulating views of both current and future impacts of micros in higher education.

Dr. Baldridge pointed out that information systems professionals in the past have been viewed as the "computer priesthood," and suggested ways in which they can work today to best serve institutional needs with regard to the introduction and use of micros on campus. He also listed several ways in which the micro revolution could be sabotaged, and cautioned the audience to try to avoid counter-productive activities on campus.



J. Victor Baldridge
Director, UCLA Microcomputer Institute

The St. Francis
CAUSE

AWARDS LUNCHEON

Program Chairman Gary D. Devine presented tokens of appreciation to members of the 1983 Program Committee and Registration Staff. CAUSE President James L. Strom presented the fourth annual CAUSE Recognition Awards to Vinod Chachra for Exemplary Leadership and Patricia C. Skarulis for Professional Excellence, and the third annual *CAUSE/EFFECT* Contributor of the Year Award to Carolyn J. Mullins. President Strom also introduced the three new officers of the CAUSE Board of Directors and awarded Certificates of Appreciation to the three retiring Board Members.

Outgoing CAUSE President James L. Strom presents gavel to newly-elected President Charles H. Naginey.

1984 CAUSE President Charles H. Naginey presents outgoing President James L. Strom the CAUSE President's Plaque.

1984 CAUSE Secretary/Treasurer
James I. Penrod

1984 CAUSE Vice President
John A. Monnier

RECOGNITION AWARDS

Vinod Chachra (center) received the 1983 CAUSE Award for Exemplary Leadership for his advocacy and support of administrative information systems in higher education both at Virginia Polytechnic Institute and State University and at the national level. Information Associates, sponsor of the Recognition Awards, is represented by their President John G. Robinson (left), with CAUSE President James L. Strom (right).

Patricia C. Skarulis (center) of Duke University received the 1983 CAUSE Award for Professional Excellence in the field of administrative information systems in higher education both at the university and at the national level. Information Associates, sponsor of the Recognition Awards, is represented by their President John G. Robinson (left), with CAUSE President James L. Strom (right).

CAUSE/EFFECT CONTRIBUTOR OF THE YEAR

The CAUSE/EFFECT *Contributor of the Year Award was presented to Carolyn J. Mullins for her contribution to* CAUSE/EFFECT *of a feature article entitled, "Do You Hear What I Say? Do You Read What I Write?". Pictured from left to right: Jerry Young, Systems & Computer Technology Corporation (sponsor of the* CAUSE/EFFECT *Contributor of the Year Award), Carolyn J. Mullins, Virginia Polytechnic Institute and State University, and James L. Strom, CAUSE President.*

PROFESSIONAL PRESENTATIONS

The CAUSE 83 Conference theme, Information Resources and the Individual, was addressed through 42 presentations in six subject tracks, as well as through special interest sessions and vendor presentations.

SPECIAL INTEREST SESSIONS

CAUSE 83 provided conferees a forum to meet and exchange ideas on topics of special interest or concern. Seven special interest sessions were scheduled at CAUSE 83. Summaries of the sessions are included in this section of the *Proceedings.*

ADMINISTRATIVE SYSTEMS QUERY (ASQ)
Dana S. van Hoesen, Moderator
CAUSE

EDUCOM COMPUTER LITERACY PROJECT
John McCredie, Moderator
EDUCOM

***IMS**
Sandra Dennhardt, Moderator
University of Illinois

INFORMATION CENTER
Ronald Smith, Moderator
University of Utah

MICROCOMPUTER APPLICATIONS
Dennis Berry, Moderator
University of Colorado

PROJECT MANAGEMENT
Ann Thorsen
Michigan State University

***REQUEST FOR PROPOSAL (RFP)**
Charles N. Naginey, Moderator
Pennsylvania State University

*Summaries unavailable.

Microcomputer Applications was the most popular Special Interest Session.

CAUSE

The Professional Association for Development, Use, and
Management of Information Systems in Higher Education

ADMINISTRATIVE SYSTEMS QUERY
CAUSE83 SPECIAL INTEREST SESSION
POST-CONFERENCE SUMMARY

The ASQ Special Interest Session was held at 5:00 p.m. on Monday, December 12 in the Borgia Room. Approximately eight people attended the session, which was geared toward offering a detailed explanation of the ASQ service. The session began with a ten minute presentation of how the service was constructed, how it works, and how it can benefit CAUSE members. After the presentation, the session opened for questions and discussion.

As a data base query system, ASQ has impressive capabilities as a tool for information system decision-makers. Ranging from the search for facts about who to speak with about microcomputers being used for cash flow projection, to the location of institutions using large proprietary software packages for student information systems, ASQ can provide important answers to questions facing today's administrative system management. A telephone call to the National Office can be all that's needed to obtain information of significant value to your institution's administrative development, since answers to ASQ queries can frequently be given during the telephone conversation. If there is a need for a detailed or complex set of data to answer the question, a formatted report is sent, usually within a day.

CAUSE 83 SPECIAL INTEREST SESSION

EDUCOM COMPUTER LITERACY PROJECT

EDUCOM has initiated a major new project to meet the national need for information on computer literacy programs and materials in higher education. In addition to the information gathering and dissemination, the EDUCOM Computer Literacy Project (ECLP) will offer supportive services: a computer literacy newsletter, computer-based telecommunications, seminars, and conference presentations. The ECLP is developing a "leadership component" to identify and promote a variety of exemplary models and recommend guidelines for effective computer literacy programs.

For additional information on EDUCOM Computer Literacy Project contact: Kimberly S. Wiley, Project Research Director, EDUCOM, Princeton, New Jersey.

CAUSE
SPECIAL INTEREST SESSION
'THE INFORMATION CENTER'

DECEMBER 12, 1984

MODERATOR: Ronald Smith, University of UTah.

The session was attended by about 20 people, many of whom participated in the discussion. I commenced the meeting by attempting to identify the mission of the Information Center, based mainly on what I had gleaned from a recent class I attended with IBM. I then identified four people in attendance who had Information Centers established, and called upon them to give us the benefit of their experience.

Each of the four had a Report Writer as one of their main products offered to users. All appeared to have problems with security, and were concerned about the possibility of users' being able to impact the rest of the DP environment. Downloading of data to microcomputers was allowed in most cases, but uploading to the main frame was not. Problems have been encountered in downloading which may result in redundant data being maintained independently, and getting out of sync with the main frame files.

Two of the established centers had user groups, which they declared to be extremely helpful. All found that group education was very successful, although one on one was also necessary.

CAUSE 83
MICROCOMPUTER SPECIAL INTEREST SESSION
Summary

The discussion addressed four primary areas:

Communication with Mainframes

There was a great deal of interest in file transfers between microcomputers and IBM mainframes. Cornell is using PCTALK in an asynchronous mode through a protocol converter to download accounting data at 1200 baud. A program on the mainframe formats the data into a CMS file in Lotus 1-2-3 format. Columbia is using KERMIT to do the same type of thing. Both PCTALK and KERMIT are in the public domain and are available for copying. IRMA boards are being used for 3270 terminal emulation.

Hardware Maintenance

Yesheva University charges a monthly maintenance fee. They have two people that maintain the microcomputers on campus. They find that disk drives need the most maintenance, and that the maintenance is greatest in areas where smoking occurs. The training that IBM provides in PC maintenance is poor, and it is often extremely difficult to get parts. No matter how good the training program is, the problem in getting parts makes maintenance difficult.

Training

Training of administrative users deals mainly with the basics of word processing and spreadsheet applications. One institution was using students to train administrators. The administrators enjoyed both the training and the contact with students. Another school found IBM PC user groups helpful in bringing together academics and administrators to discuss common problems. In addition, there are some good computer assisted instruction packages. Specific titles were not discussed.

Software Packages

A number of schools are using MultiMate, a microcomputer package designed after Wang word processing. Colorado is interested in NBI word processing for the PC because of its ability to interface with larger NBI word processing systems. VPI found Script VS and ReadiWriter to be good packages. In terms of database management software, Databasic, Condor, and Knowledge Man were all in use, in addition to dBaseII. Penn State is using Corvus in one college to network PCs. It was suggested that it would be helpful if CAUSE would be a broker for microcomputer software, buying in volume and passing on the savings to member institutions. (NOTE: This proposal was discussed with Chuck Thomas, Executive Director of CAUSE, who indicated that CAUSE had stayed out of the brokering business since EDUCOM was doing this type of thing for hardware. He suggested that EDUCOM might be interested in brokering software as well. In addition, the National Association of College Stores (NACS) handles quantity purchases for their members.) There were few suggestions to address the problem of unauthorized software duplication.

Project Management Special Interest Session Discussion Summary
CAUSE '83

Time and cost estimation is still a major problem. In most organizations, estimating depended more on project leader experience than on formal estimating techniques. A few organizations, most of them using formal techniques, produced some overestimates. These hurt productivity, since work took at minimum the time estimated. But most people reported frequent underestimates. Some improved estimates by using data on past projects from an automated tracking system; they relied on project leaders to assess project similarities.

To help keep commitment to long projects, several people used intermediate project deliverables, such as design documents.

Several organizations based design or programming staff in user departments, which improved user commitment and forced priority-setting. Some newly-distributed staff members still tended to congregate at the central site.

One person reported a prototyping attempt: Relatively inexperienced staff members, who proposed that approach, couldn't control the project.

TRACK I
Issues In Higher Education

Coordinator:
Earl A. Nienhuis
University of Illinois

Richard Breslin
Iona College

Judith Leslie
Pima Community College

Richard Howard
North Carolina State University

Phillip Rokicki
University of Missouri

MYTHS AND SYMBOLS OF INFORMATION TECHNOLOGY

ROY TALBERT, JR.
UNIVERSITY OF SOUTH CAROLINA
COASTAL CAROLINA COLLEGE
CONWAY, SOUTH CAROLINA

ABSTRACT

This paper analyzes concepts and symbols of the language of information technology. Most important is the idea of "revolution," that technology is creating a revolution comparable to major shifts of the past. Other key concepts include the perception of a "literacy crisis," the presumption of a moral and ethical dilemma, the orientation toward the future, the promise of productivity (next to "revolution" perhaps the most telling symbol), the image of an elite who use a special language unintelligible to the uninitiated, and the symbol of the infallible machine.

MYTHS AND SYMBOLS OF INFORMATION TECHNOLOGY

As I immersed myself in the language of information technology at Pepperdine University's 1983 Computer Literacy Institute, I became fascinated with the images and symbols of that language. Beyond receiving a basic introduction to the electronic workplace and learning to use a variety of software packages, my own training as an intellectual historian kept bringing my attention to the very strong and numerous images which seemed to abound in every presentation, in every slide, and in every handout. The historian of ideas searches the language of a society for critical symbols and images which constitute the climate of opinion of a particular age or culture. This paper is an attempt to record and explain the symbols and images which appear to be intrinsic to information technology.

I have used the term "myth" deliberately, but I must confess at the outset that my analysis, especially on this point, can only be speculative. It is simply too early to judge which of the images and symbols of information technology will later be found to be false and thus mythical. Only hindsight can make that determination, and we have not accumulated very much perspective in this field. It does seem reasonable to suppose that future analysts will look back and think us odd for having so strongly clung to this symbol or that image. The point here is that in terms of the contemporary impact of our beliefs, expressed in the symbols we use, it does not matter whether or not they are false--we act on them as if they were true. That some symbols may later be dismissed does not in any way diminish their present cultural significance when they are held to be valid.

The reader may have observed that this paper is considerably different than others of a general nature on the place of information technology in our society. For example, we are already on page two and the term "revolution" has only now been used. What general assessment of information technology can you think of which does not begin with the obligatory statement of the extraordinary revolution presently underway? I suggest that in the term "revolution" we find the greatest symbol of contemporary information technology, and within this symbol we find a large subset of other images. This revolution will change, we are told constantly, our very way of life; indeed, it will change the way we think. As that fascinating documentary, "Goodbye Gutenberg," says, the revolution will bring "a new moral order."

The idea of revolution has been an especially powerful symbol for Americans, founded as we were by revolution, and in the course of our history we have spotted numerous other revolutions. We seek out revolutions with a passion greater, I think, than any other culture. Aside from politics, economics, and technology, we proclaim new brands of washing powder to be truly revolutionary. It is simply a part of our conventional wisdom that we are in a period of great change caused somehow by the computer. Our only problem has been to estimate the size of the change, for I can find no one who doubts the existence of some kind of revolution.

How revolutionary is this revolution? The estimates vary, but all suggest that computers represent a change on a major scale. "As much a revolution as the printing press," says one spokesman, and if I understand the meaning of the expression "Goodbye Gutenberg" some suggest more important than movable type. Frequent comparisons are made to the Industrial Revolution, a term first used in France in the 1820's to compare it to the political revolution of the late 18th century. A more daring, although perhaps whimsical, comparison is found in the increasing use of the term "B.C." to note the period "before computers." While there has been no suggestion as yet that we revise our dating system, although this sometimes occurs in revolutions, we are obviously dealing with a very powerful symbol here.

My own preference for a comparative revolutionary symbol is the introduction of the railroad. Perhaps no other technological innovation of the nineteenth century provided a more striking image. The locomotive was seen by virtually every observer as "annihilating time and space" (indeed, our present time zones were developed because the railroads so drastically decreased space), and the great cathedrals built to house the terminals are clear expressions of the strength of this symbol. Perhaps the most important aspect of the revolutionary image associated with information technology is that, as in the case of the locomotive, we have judged the computer as revolutionary very early on. We sense a revolution here, and the idea is so powerful that we embrace that image needing no hard evidence. How could it, we seem to say, not be revolutionary?

In a political revolution there usually exists a cadre of hardcore militants, the real revolutionaries, the Sons of Liberty, the Jacobins, the Bolsheviks, who provide a structure for spreading the revolutionary word. A few years ago we might have called it the infrastructure, but today we would probably call it the "revolutionary network." That term "network" is now used widely across our society, although no one to my mind has bothered to provide any particular definition. Such generality is perhaps the very heart of a symbol which we use intuitively. Regardless of the lack of specificity, there is ample evidence of the existence of such a computer network. You have only to check your membership lists to see them. CAUSE, EDUCOM, and numerous other organizations have appeared to provide both internal lines of communication within the revolution and to offer vehicles for the propagation of the gospel. That the computer "movement" is embraced as a "cause" is clearly evident by the name, chosen rather deliberately I think, of the organization sponsoring these papers--CAUSE.

To carry the political revolution analogy further, the hardcore revolutionaries serve as the elite of the movement, proclaiming the inevitability and magnitude of the revolution. This group appears to consist of at least three primary elements. First, there are the practicing computer scientists and engineers who provide the technical innovations. Next, we have a more vociferous, if less technically trained, element serving as the popularizers and mainstays of the networks, who act as missionaries in spreading the message. Finally, we have the marketing arms of the companies who produce information technology products for profit and who at least equal the popularizers in their aggressiveness. The professional computer scientists are the Newtons, the Darwins, and the Marxs of the revolution, and the latter two groups are the Voltaires, the Huxleys, and the Lenins.

Corresponding to the concept of the existence of a computer elite is the image, which seems to be held on the popular level, of the computer world as one of mystery and perhaps even secrecy. The elite are known by their ability to speak "computerese," that most difficult language. The existence of a special language and the perception of mysteries easily gives rise to the image of a priestly class of computer experts who commune only with each other, and who deliberately protect their secrets from the unwashed masses.

This priestly class, on the other hand, demonstrates considerable missionary zeal, and here the elitist image contrasts with one which is clearly inclusive. One hesitates to continue the religious metaphor, but there is a hint in the language of the initiates that it is essential that we all become true believers, generally through a process of conversion to the importance of computers (faith) and by adapting the new technology to one's own field (works). There is also some distinctly democratic imagery in the call for a computer literate citizenry in which all participate in the revolution. One computer egalitarian even claimed that "equal opportunity . . . might be endangered unless everyone is enabled to gain a competence in programming." With the image of a mighty revolution, after which nothing will be the same, it is obvious that those who resist conversion cannot achieve that great American goal of being "contributing members of society." One recent analyst called the insistence on universal programming skills "pathetic technological me-tooism."

The sense of urgency associated with the call to participate in the revolution is another of the overarching symbols of our time. Like revolutions, Americans are quick to see a crisis, and the one which is currently shaking the foundations of our educational system is something called the "computer literacy crisis." We have only vague and conflicting notions of what is implied by the term "computer literacy," but for the last few years we have seen increasing claims that competency in the use of computers is a basic skill as fundamentally important as the traditional 3-R's. I am unaware of any recent study of education in this country which has failed to take note of the computer literacy gap.

It is fascinating that we seem to stress this particular crisis out of some very typical American values. We want to do right by our children; we desire to prepare them for the future. Parents understand their own inability to deal with computers, and the deeply ingrained idea of progress drives them to make certain their children are not similarly handicapped. One of the clearest messages in commercials for home computers is the same as that in advertisements for toothpaste--if you are a good parent, you will buy this product for your children. I suspect there are a growing number of parents who purchase computers without any idea of putting their budget, or tax records, or recipes on them. They buy them for their children out of a sense of doing good for them.

As a chief academic officer I must report that the response to the computer literacy crisis is at all levels rather remarkable. In the short space of two years the availability of microcomputers in my local public schools and at my institution has grown from nearly zero to a substantial level, with plans for nothing less than universal availability. I am simply amazed at the response, particularly on the level of the college faculty which is generally one of society's most conservative groups. In the halls and dining rooms one can hear Assistant Professors of English speak casually of disk drives and modems. In a recent University of South Carolina competition for research grants in the Arts and Humanities, 44% of the proposals detailed the use of computers in their projects. That is an astounding conversion rate in a group typically considered recalcitrant regarding the new technology.

Like any real revolution, either political or religious, this present one in information technology is future-oriented. We are urged to join the movement because of the wonderful future which awaits us. No doubt this fascination with the future stems from the extremely rapid rate of technological advancement. Since systems are usually no sooner installed than they are obsolete, our attention is always on the system which is being developed. My local experts exhibit no embarrassment when they tell me that whatever we are contemplating purchasing will last for only three years. And only the latest and most expensive devices and applications are acceptable. No one at my campus could possibly be satisfied with a matrix dot printer, but all have the most elaborate justifications for letter quality devices. I am surprised that we continue to get by for the most part with black and white monitors, and I am resigned that soon only color will be acceptable. The image here seems to me to be that imperative set forth so clearly by Jacques Ellul in his brilliant The Technological Society: "If we can, we must."

The orientation toward the future has been typical of the western mind at least since the Enlightenment. The future is the heart of the idea of progress, and our very identity tends to be expressed in what our plans are. Only a few years ago in my history classes I was calmly, and a bit sadly, discussing the death of the idea of progress. It seemed to me that the trauma of the twentieth century, coupled with the image of growing scarcity and environmental concern, meant that the fundamental ideas of growth and progress were undergoing considerable change. To the contrary, the fascination with the promise of the future has received a gigantic new emphasis with our contemplation of the Information Age. The extravagance of the promises of the future, driven by the projected productivity of the new information industry, rivals the claims of earlier technological enthusiasts during the Industrial Revolution. I recently noted with great interest the change in my local computer store's name to "Future Systems."

Perhaps the greatest image, next to "revolution" itself, is that of "productivity." On the heels of national concern about a dropping gross national product, even as we faced the cultural shock of losing major industries to other countries, the computer revolution allays our fears with the guarantee of nothing less than a revolution in productivity. South Carolina's 1983 State Plan on Technology claims a minimum increase of productivity of 40%-60% by using word processing. The plan adds that we "have yet to understand where the upper boundaries are on the potential for improvement in productivity through office automation."

This image of increased production is so fundamental to information technology that I am loath to analyze it in any terms which might seem critical, for here we are dealing with one of the great and sensitive, one might say sacred, aspects of our relationship with computers. In the interest of candor, however, I must confess that I am unable to determine just how the IBM PC restores sanity and increases productivity in the business of the Charlie Chaplain figure who we see so frequently on commercial television. I am also uncertain just how productivity is increased when my secretary uses a word processor. I understand labor is saved and time is freed, but for the life of me I do not always see an increase in productivity when the volume of work is limited. I respectfully suggest that we know very little about the real, long-term effect of computing on productivity in the small business and office. We can note a fairly high rate of frustration on the part of some small businessmen. As one friend said when asked about his company's computer: "I parked it."

In one area we have seen a most definite increase in productivity. I refer to the making and selling of computer hardware and software. What a huge and competitive industry has sprung up, and its methods and claims are as outrageous and energetic as any young revolution can be. One is tempted to suggest that the vendors fan the flames of the computer literacy crisis out of a desire to increase sales. No one has ever indicated that marketing and advertising techniques are developed out of the purely altruistic desire to help society.

Another image found frequently in information technology is the idea that somehow with the computer revolution we are faced with an ethical and value crisis. While it is generally accepted that technological innovation may cause cultural lags, challenge traditional values, and present ethical problems, there is no evidence that computers have caused any significant or new ethical dilemmas. The considerable, if very general, discussion about this "problem" may have resulted from the fact that until quite recently posing the ethical question was the only way to get traditional humanists involved in any kind of dialogue about the impact of computers.

Computer crime and computer security, or insecurity, have received wide publicity of late, but although the techniques are different, the fact remains that theft is still theft, as is illegal entry, and there is no real qualitative difference when we face these issues in information technology. Like the argument over values, the threat to computer security, while it does not evaporate because it certainly is a problem, becomes more technical and less philosophical and revolutionary.

Another aspect of information technology which reinforces the mystique and image of the power of the computer is the symbol of the machine as infallible. I call this the "pilot error" syndrome. Simply put, the machine does not err, humans do. We express this in the now generally accepted statement, "garbage in, garbage out." Guilty humans, suffering from a kind of technological original sin, are thus inevitably placed in an inferior position to the inerrancy of the computer which always and forever remains innocent. If this image of man as inferior to the machine is not eliminated as a meaningless myth, it may indeed turn out to work the sort of magical changes in how we view ourselves suggested by computer enthusiasts.

Lastly, it seems worthwhile to comment on the nature and tenor of the words used in information technology. We have dropped the term "data processing" for the more refined "information" processing. Data has a raw and pedantic air, while information is finished and dynamic. When consumers reacted to the harshness of the computer, we invented the term "user friendly." Terms such as process, system, network, friendly, real time, interactive, literacy, language, and access are by no means cheap words. They are significant, denoting authority and power, and they show the value we place on the technology.

We are told that computers will change our very way of life, and that no one will escape their influence. We look forward to such a world positively, confident in our faith in the promise of the future. The Industrial Revolution had its detractors from near the very beginning, but the Information Revolution has no philosophical critics. We find only latter day versions of Henry Adams, who in the late nineteenth century embraced the dynamo as the symbol for the new age.

Like Adams we are overwhelmed by a sense of awesome power, this time of the computer, and we cannot envision any limit to its implications for change. Whether or not we are correct in our boundless enthusiasm does not at the present matter. What does matter is that we believe we are in a great revolution of the highest magnitude, and we are riding the waves of technological change with a new optimism and a sense of inevitable progress unknown in recent years. No doubt reactionaries and counterrevolutionaries will appear soon enough, but for the moment how fascinating it is for our society to be so assured of the greatness of our future.

The Use Of Quantitative Information In Higher Education Decision Making

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In recent years higher education decision makers have been bombarded with a barrage of decision support tools. Fourth generation data management systems are now becoming available which allow those without computing expertise easy access to computer-based information. Microcomputers are making their way into many offices for smaller computing tasks and for help in achieving computer literacy. Further, computer-based modeling systems have become an integrated part of the budget and mid-range planning cycle at many institutions.

Yet each of these decision support tools has a major limitation for each is based in the quantitative dimension and is often insensitive to major factors which play an important part in institutional decision making. Issues such as the mission of the institution, program quality, as well as the political dynamics both inside and outside the institution play a major role in decision making, yet are not easily (if at all) quantifiable. How then does the institutional decision maker make decisions using the state of the art tools in the computer and information technology without neglecting the nonquantitative realities of the day?

This paper seeks to begin to address the above question in a practical manner. Research on institutions using computer-based planning models as well as observations of an institution presently working toward the use of information technology serve as the basis for a number of observations on facilitating the use of quantitative tools in higher education decision making. Suggestions are directed to those in the institution who will be working with decision makers, and focus on how such individuals can assist the decision maker in the development and usage of computer-based tools. The paper then shifts to a recommendations section where several keys to successful implementation of decision support tools are shared.

Introduction

One of the things I look forward to each academic year is the opportunity to attend a national conference on the use of computer technology in higher education admininstration. Like many of you I am excited about the tools presently available in the areas of computer hardware and software, teleconferencing, networking, video disks, etc. Without a doubt, these tools are having a profound impact upon society and, hence, upon higher education. The ability for a middle or senior manager at a college or university to have almost immediate access to information on students, finances or donors through the use of a "friendly" data management tool, as well as the ability to then take those data and work with them further to produce a final report (perhaps with computer graphics) which can be incorporated into a word processing document and electronically mailed to several individuals in the university will, I'm sure, dramatically alter the way we do business in higher education administration in the next few years.

Indeed, it is exciting to be among colleagues who are exploring the use of all this new technology in higher education administration. That is until, in a reflective moment, I consider the decision makers who supposedly are to be the recipients of all this wonderful technology. Unlike us, many decision makers are not that excited about the advances being made in the information technology field. Their feelings are perhaps more in the area of indifference, skepticism, or down right hostility. As one who has been given the charge to facilitate and promote the use of computer-based information by decision makers, these attitudes, of course concern me. I have thus spent a fair amount of time these past few years trying to better understand the basis for the attitudes that these decision makers have. What I would like to share with you this afternoon are a few of the observations that I have in this area in the hope that they may prove helpful to you as you deal with many of these issues.

Issues

1. To what degree is quantitative information useful in decision making?

When some of the early computer-assisted tools were first used in higher education a decade or so ago, some argued that their usefulness would be severely limited. Major decisions in higher education, many said, were made of the stuff that could not be placed into computers. Institutional mission (often with multiplicity and conflict of goals), academic quality, human interaction, and bargaining were vital aspects of the decision-making formula, all of which would be better left to the human mind which would be able to deal with such information better than a cold and inhuman computer. Many have voiced objections to a growing dependence upon computer programs to deal with the complex issues of the higher education decision maker. In my own research in the use of computer-based planning models by higher education decision makers, I have found that the inability of computer-based tools to deal with qualitative issues, as well as the questionable nature of some data in certain areas of decision-making, often negates the value of such tools with decision makers in general.1

What perhaps disturbs me the most about these arguments against the use of computer-based decision support tools is that, in many respects, I believe that the critics are right. As John Thelin points out in his book Higher Education and Its Useful Past, institutions of higher education were making key decisions concerning curriculum, building plans, or future developments long before computers were present in administrative offices.2 What is shocking to those of us in the new information age, these naive and computer illiterate decision makers actually made some pretty good decisions! If we seriously believe that computer-based tools have a valid place in higher education decision making, we need to come to grips with the issue of what place such instruments have in the decision-making process. For one reason or another we have not addressed that issue to the extent that it is needed. We have become infatuated with the whirs and buzzes of the new information technology, we count the things that are easy to count, measure the things that are easy to measure, but fail to seriously ask the hard questions as to what usefulness such technology has to the senior decision maker who must deal with issues not easily placed on our wonderful computers.

One of the first issues we must deal with in this area is the appropriateness of using quantitative information in various administrative decisions. Whether they like it or not, higher education decision makers do live in a quantitative world where numbers related to students, tuition charges, salaries and building costs do matter. As much as we would like to imagine that higher education decision making is very different from that of the business world, we are, like them, very much restricted to the limited resources available, much of which can be quantitified. Quantitative computer-based tools can help the decision maker deal with the most current information available in making a choice as to the best path to travel in a particular policy area. We who deal with decision makers must, however, realize that in some decisions computer-based quantitative information may only present part of the whole picture that the decision maker has to consider in reaching a final decision. We must be committed to helping the decision maker weigh the value of such quantitative data in light of other, perhaps more important, information available. We must also realize that there may well be some decisions where our quantitative information, no matter how current, accurate, or impressive, is not appropriate for the particular decision at hand. In such cases we must be able to put aside the charts and numbers lest we compromise the value of computer-based tools in general in the eyes of the decision maker. What is perhaps most important in this area is the realization that decision support tools are intended for the support of decision making, not a replacement of the decision-making process. We must always be promoters of decision makers utilizing the best quantitative information in the decision-making process, and at the same time realize that this information must be used in tandem with other information available to the decision maker at the time.

2. Use of quantitative information in the management process.

Another important area which needs to be addressed is how computer-based tools can be used on a day to day basis to help the managers better administer their particular areas of the university. It would seem to me that the majority of energy that has been spent on information technology in recent years has gone into developing tools, with very little effort spent in helping managers work through the use of such tools in their jobs. Even in applications where quantitative information is necessary, there are many managers who simply do not know how to use the new information technology. In our quest to help managers deal with this issue, we must be prepared to do more than just plug in the terminal and show the manager how to work the keys. We must be prepared to address the organizational issues which will arise as computer systems make some jobs obsolete, change the skills necessary to work in other positions, and perhaps drastically change the way some offices have done business for several years. The facilitator of decision support tools must be equipped to deal with personal issues which may arise as a result of major changes in specific offices or throughout the university.

The promoter of decision support tools must also be ready to deal with managers in some areas of the college or university who have other concerns to deal with relevant to computers being used in their divisions. It has been stated many times that current and accurate information is perhaps the chief benefit of computer-based systems. It does not take long to realize, however, that to some people current and accurate information is a threat. There are no doubt some managers who are very concerned about their own ability to manage and are afraid that the use of analytical tools will show them to be poor managers, or at the least, managers who are not able to cope with the productivity tools of the future. It is easy to say that managers of the future (or the ones who make it to the future) will be those who are able to adapt and learn how to survive in the technological jungle. However, as the instigators of computer tools, I believe it is our responsibility to do everything we can to help the current manager (as computer illiterate as he or she may be) to both understand and be able to actively use these new tools in their daily business. This task will be somewhat difficult to do if we have not worked through the issues in this area in regard to our own management of resources. We must become role models of managers who are able to use quantitative instruments in decision making, as well as promoters and educators of such tools being used by others. To do this we must work through many of the issues involving how useful such information is to us in our own area in terms of day to day decision making. Only then will we begin to appreciate the struggles that other managers have in implementing decision support tools in their own offices.

3. How does using quantitative information affect the political process?

One of the more interesting aspects of the study of using quantitative information in higher education decision making is the interaction that often takes place with the political dynamics at a particular institution. Most observers of higher education decision making place a lot of value on the political dynamics at work in most institutions in decisions that have an impact upon the university. Decision makers must deal with other decision makers either individually or in a group setting to determine the course of a particular program or project. Obviously the multifaceted goals and objectives of the college or university, which are often in conflict, also come into play when such programs or projects compete with each other for limited resources. The decision maker who is at a disadvantage in such a discussion perhaps because he does not have the most current and relevant data, is at a political disadvantage in general. If information is power, then the decision maker of the future who is able to use computer-based tools to supply himself with the latest information will have the "goods" on someone who does not have access to, and the ability to use, such information. Again, if we are to promote the use of computer-based tools we need to deal with issues of availability and access to information by all decision makers, as well as to the dynamics of personal and group interaction in the decision-making process. If we value computer-based tools, and are going to promote the use of quantitative tools in general in higher education, we had better be prepared to understand and work with the political dynamics of higher education decision making.

4. The use of new types of management tools by decision makers.

The kinds of issues that I have spoken of thus far could be present with any decision maker trying to make use of a computer-based tool, whether that be an electronic spread sheet similar to what he used to do by hand, or a data base managment system following a principle similar to what he used to have in a 3x5 box of cards on his desk. Many decision makers will have problems using computer-based tools just because they exist on a computer, and because additional training and perhaps overcoming uneasiness will be needed. However, many of these applications will be familiar enough to the decision maker so that once the computer uneasiness is overcome the tools will become useful. Quite another situation exists for those who attempt to implement computer-based tools which demand a different form of thinking by the decision maker. One such tool is the computer-based planning model that allows the decision maker to examine the effects of present decisions in terms of long range financial or other resource management. Unlike the tools where the logic is familiar to the decision maker, the world of computer modeling is often strange and thus involves time and effort by the decision maker to understand the benefits of such work.

In my own study of modeling and its usefulness in over one-hundred and thirty institutions, I found that for this decision support tool (or really any other) to be helpful to the decision maker an attitute of openness had to be present. Decision makers who have problems working with the new technology are often those who because of habit, ease of access, or just plain laziness, would rather depend on the old sources of information in a traditional form. They tend to do this even if the old sources of information are incorrect or out of date. Decision makers, like all of us, are after all creatures of habit.

The decision makers who will make use of the tools of the future will be those who are able to break the old habits and begin to think creatively about how to address the issues of the day. This may well mean that such previously unused instruments like computer models or statistical analysis might be used, not to replace the decision-making process, but rather as a tool for the decision maker to use in that process. In my study I found that those who were successful in modeling did not differ in educational emphasis or level, background in higher education, or even job classification, from those who failed in such efforts. They did, however, possess a desire to address the issues of the day in a new way and had an openness to approach problems from a new angle.

For those of us who have the task of facilitating such an attitude of openness in our institutions, there seems no easy answer if this attitude doesn't already exist. Certainly patience and sensitivity to the decision makers' viewpoints helps. (A severe financial crisis that reveals the danger of working with wrong or outdated data helps even more!) Like any good change agent, we must realize that any change will be gradual and no doubt occur over many months or years. Thus we must identify opportunities for the progress, whether that be with an individual who is open to the new technology, or a specific event (e.g. a budget planning meeting) where a specific step could be taken. Look for specific opportunities for change (not just the "blue sky" picture of what you would like to see ten years out) and make the most of opportunities for change that you see.

5. Strengthening the Suppliers of Information.

It is true in my institution, like perhaps many of yours, that there are several senior decision makers who are (or will be) using the new tools in their work through first-hand use. It is also true (especially in the next few years) that some senior decision makers will have to rely on others for the information gained from the new technology instruments. For these decision makers we must address the issue of using the new technology second hand (i.e. through another decision maker, a subordinate, or perhaps through an office of Institutional Research). It is perhaps a mistake to believe that because a decision maker does not have a terminal on his or her desk that they do not need training in the new information technology. Again, in my own setting, I find that the users of computer-generated information need to be educated in the form such quantitative information is kept and how it can be accessed. The decision maker can then request the information he or she needs (knowing it is available and it can be reported in such a fashion) in keeping with the need for information rather than the "availability" of information. Decision makers who can "call the shots" as to what information is acquired (and in what form) for a particular decision don't feel as uneasy about using such information in decision making. When they have no control over how information is reported, however, they tend to resist right from the start.

A major element in the use of computer-generated quantitative information for the decision maker without direct access (or perhaps who choses to be supplied) is the skill and ability of a intermediary party. This person must be someone who is intimately acquainted with the data, the way the particular system can work and report on data, as well as the way a decision maker wishes the data to be presented. Such individuals have at times been labeled "integrators" and their work has proven to be a key element to the success of decision support tools at many institutions. Andrew Masland at Pennsylvania State University found this to be especially true in working with computer modeling applications.3 Having someone in a "decision consultant role", as Masland states, is important in formulating and analyzing the problem and in synthesizing a solution. Such an individual is obviously more valuable if they are resident at the university. The best situation would, of course, be for each decision maker to have his own decision consultant. However, such individuals are hard to come by and don't exist in sufficient supply for this to be possible.

Recommendations:

Although there has already been a fair bit of advice given in my comments, let me close by offering you a few specific recommendations which may be of help. These recommendations are directed to those who wish to promote the use of computer tools and quantitative information, whatever office of the institution they work in.

1. Identify and develop the integrators in your institution.

I am convinced that integrators, the individuals of whom I have just spoken, are so critical to the success of using quantitative instruments in decision making that I strongly suggest that you identify (or create) such individuals and do everything you can to develop their technical and managerial skills. In looking for such individuals, give preference to those with personal relations skills (the technical information can be learned) and to those who have a healthy respect for the complexity of the decision-making process as well as an appreciation for the nonquantitative measurements. If you find such an individual, get the most out of them while you can. They are no doubt on their way up the career path and may not be available for long.

2. Invest resources in training middle and senior managers.

It is all too common for us to spend large amounts of money on hardware and in developing software at our institutions with very little effort expended in developing the human resources that will use the information which is produced. We need to drastically alter our actions in this area. Education of the users of decision support tools is the critical ingredient which, although takes the most time to develop, costs the least. And this education needs to be on the part of decision makers as well as ourselves: they must learn the new technology, we must learn their needs, and together we must explore the potential applications of computer technology which address user needs. Part of this educational process will involve a serious dialogue with decision makers which will include a great deal of listening on our part. Listening to the questions, concerns, and perhaps even fears that decision makers have. We will have to begin to address the issues of the day not with fast and easy answers, but with a well thought out response which shows respect for the concerns that have been voiced. It is only through this open and honest exchange that an integrity can be associated with our work. And it is only after this integrity is developed that our function as change agents can fully utilized.

3. Examine the ways quantitative information is reported.

We have all heard of the ways information can be obtained and manipulated using various decision support tools. It is unfortunate that at the same time we hear relatively nothing about how such information is most effictively presented to decision makers. How does one best summarize a great deal of information for senior decision makers so that only the essence of the data is presented? How can charts and graphs best be used to show summary information or relationships? How does one use various media or educational techniques in presenting information to decision makers in a group meeting? How can "live" on-line demonstrations be used in the decision-making process? These questions are fundamental to the use of the new technology in higher education. We all need to begin to address the answers to these questions and to share our findings with one another.

4. Study the decision making process and the use of quantitative information in it.

I have already stated that the subject of how quantitative information is used in decision-making needs to be addressed. That is true for higher education in general. However, each of us needs to address that subject for our own institution. We must know the decision makers at our own institutions and their perspectives with regard to the use of quantitative information and its usefulness (or potential usefulness) in their area. In many respects we must know better than the decision maker the data that are kept on students, faculty, or material resources, and how they can be reported and used in various decision-making activities. In a very real sense we must go far past this understanding and become students of the governance and decision making process in higher education. We must be able to see things from the senior decision makers viewpoint, with multiplicity and confict of institutional goals and objectives, with limited resources with which to work with, trends to follow, and awareness of projections for the future. Ray Bacchetti of Stanford was right when he stated that very little is known about how decisions are made in colleges and universities, and even less is known about how they should be made.4 Realizing that we are all rather ignorant about this subject, I would like to suggest that we take whatever steps we can to become educated. That might well include attention to written material on the governance of higher education, or attendance at a conference or workshop that deals with the subject. That might also include spending more time with the people who will be using the tools that we develop, and beginning a dialogue with them so that they may educate us as to their real needs for information. It would seem to be obvious that "decision support tools" are meant to do something very specific, that is support decision making. It's time that we begin to address this issue with the development and use of our quantitative computer-based instruments.

Footnotes

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A NETWORK FOR THE FUTURE: FORMING A PARTNERSHIP BEYOND INSTITUTIONAL WALLS

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This paper will explore the feasibility of a partnership between educational institutions and data processing companies. The purpose of a partnership would be to advance institutions technologically by utilizing the best resources of business and education.

This paper explores those issues associated with a partnership approach. Four sets of issues are presented. The first is the impact upon the individual. The second pertains to hardware resources. The third set of issues pertains to financial resources. The final set pertains to institutional climate.

The paper will conclude with a list of criteria to assist institutions to analyze their potential for forming a partnership and thereby building a network for the future.

> "We cannot wait for the world to turn, for times to change that we might change with them, for the revolution to come and carry us around in its new course ... We ourselves are the future."[1]
>
> Beatrice Bruteau

Introduction

The purpose of this paper is to present a network for the future. The focus will be on data processing in postsecondary education. Five sections comprise the paper: (1) conceptual framework, (2) variables, (3) analysis, (4) summary, and (5) conclusion. The paper should give the reader a framework to understand the change process; criteria to evaluate participants; and a projection of the future.

Conceptual Framework

Definitions

The term "paradigm" is from the Greek word paradigma, meaning pattern. It is a scheme for understanding and explaining certain aspects of reality. A paradigm is a framework of thought.

A paradigm shift is used to describe the evolutionary process. Shifts occur when too many puzzling observations pile up outside the framework of explanation and thereby strain it. A new insight is gained, usually at a point of crisis, to explain the apparent contradiction. It introduces a new principle that provides a new perspective.

Once the old has been reconciled with the new ideas, a new paradigm emerges. As explained in The Aquarian Conspiracy,

> "A new paradigm involves a principle that was present all along but unknown to us. It includes the old as a partial truth, one aspect of how things work, while allowing for things to work in other ways as well...it throws open doors and windows for new exploration."[2]

Application

A paradigm is now applied to data processing in educational institutions. It should be noted that the authors have taken liberty in using it in this manner. As a conceptual tool, however, its application appears to be appropriate as viewed by the authors. The paper describes a series of paradigms, each reflecting a given point in the evolution of data processing. Each successive paradigm is broader in scope and larger in number of participants than the previous ones. There is no intent to present one as more effective than the other; the intent is to show how each serves a slightly different environment and corresponding need.

Paradigm One. The first paradigm is a single data processing center in a single building in an institution located on one site. The center performs all data processing for the institution and one director has sole responsibility. As the demand for increased services from users increases, a greater strain is placed upon this type of operation. A likely consequence is less satisfactory services and less contented users. The conditions ripen for a shift to paradigm two.

Paradigm Two. This paradigm is larger than the first, yet still is a single operation. The institution itself is also larger. The extent of data processing services is greater than in number one. Hardware upgrades have occurred and more staff have been added. While this operation serves the institution well for a period of time, demands for services begin to increase as new applications become available. Along with this increase may also come specialized interests. Institutional politics may play a role as competing priorities emerge and personal power and authority are sought within the organization. The data processing personnel can be caught in the middle in such circumstances. The result of these dynamics occurring is often a division in operations. It should be noted, however, that this division may have been brought about by factors other than those cited.

Paradigm Three. Once the whole is split into two equal parts, it becomes paradigm three. These two parts represent administrative data processing and instructional data processing. Both halves are as large individually as the whole of paradigm one. The larger size reflects increased services required of each in comparison to number two. The division into two parts indicates probable differences in organizational structure, hardware and software, and staff. Each of these two operations will generally service the institution for some time. The element of control and the need for greater responsiveness by the user, however, may surface. As less expensive, user friendly hardware and software become available, users begin to acquire their own capability, especially for small scale data processing needs. When this occurs, another paradigm evolves.

Paradigm Four. A multi-division pattern characterizes paradigm four. Many parts constitute the whole, a whole that is larger than paradigms one, two, and three, respectively. The configuration indicates that overall more data processing activities are occurring than in the previous paradigms. Also evident is the multiplicity of parts revealing a decentralized organizational structure, likely differences among the parts in hardware and software, and many participants involved in performing their own data processing. Pressure mounts, however, to increase the scope of all data processing activities. Another strain occurs at the edges as the rigidity of the parts begins to detract from the communication among them. When this occurs, the door is open to paradigm five.

Paradigm Five. All previous paradigms were configured in squares or rectangles; the lines were straight, the corners perpendicular. Paradigm five shows a softening of these lines into rounded, curved edges. Such graphics illustrate less rigidity, and more fluidity in the decentralized data processing operations. While this configuration suffices for a period of time, users become aware of what other institutions and/or campuses are doing that could enhance what is being done in the original institution. Or, because of the need for rapid communication among institutions and/or campuses an electronic connection is sought. Paradigm six may result.

Paradigm Six. For the first time a second entity interconnects with the single entity heretofore described. This may represent an additional institutional location, another institution, or the beginnings of a consortia. It may be in response, for example, to the need for sharing scientific data, for sharing physical resources, and/or for administrative communication. Once the advantage of the communication becomes evident, the demand for more builds. Paradigm seven then emerges.

Paradigm Seven. At this point, the curved configuration with multiple parts has connected with three additional entities. As with the previous paradigm this one may entail more institutional locations, other institutions, and very likely consortial arrangements. Within this structure electronic communication is possible within the institution and among its various educational associates. This paradigm may suffice. However, two conditions may strain the paradigm. The first is that the institutions still "lack" something. It may be staff problems, such as inadequate quantity or expertise; hardware resources may be insufficient or out-of-date; and/or political factors detract from its effectiveness. The second set of conditions are those that occur when institutions are operating effectively but they want to do "more." They want state-of-the-art equipment, highly trained professionals, and they want to extend beyond the political arena. When these conditions occur, paradigm eight may come forth.

Paradigm Eight. The cumulative, multifaceted configuration extends in paradigm eight to greater numbers of participants and to one of a different nature. The new entity represents private enterprise. Though different in appearance, it interconnects in the same manner as the others and adds to the total configuration. It can bring to the configuration state-of-the-art equipment; sufficient power and capability; highly trained professionals, many of whom have been attracted away from education to industry by higher salaries, continuous training, and favorable working conditions; and business may bring an element of objectivity to the configuration that minimizes politics and maximizes performance.

Paradigm eight is the concluding paradigm of the overall framework for this paper. An assumption will be made that paradigm eight represents the network of the future. Should this be the goal, the question then becomes, how can it be achieved. The method for determining "how" will be to identify and discuss what variables may exert influence in achieving that goal.

Variables

The variables are organized into four resource categories: (1) personnel, (2) physical, (3) financial, and (4) institutional. Within each category the variables are described as they pertain both to business and education. They also are discussed as they may be manifest positively or negatively.

Personnel

The personnel variables include staff expertise, professional growth opportunity, attitudes, user satisfaction, and administrative support.

Staff Expertise. Because of the technical base required and rapid changes in the data processing field, the number of professionals generally is limited in relation to demand. For any data processing operation to be successful, particularly one in a partnership, requires highly skilled and knowledgeable professionals. Without this resource, the partnership cannot be effectively attained. Private enterprise is increasingly in a position to attract the top professionals with higher salaries than education. Indeed, the strength of the business community in the partnership may be primarily in the expertise of its professionals. Education, however, may be more attractive to some professionals given its collegiate environment and lifestyle.

Professional Growth Opportunity. Perhaps in no other field is the need for continuous training more prevalent than in data processing. Without this training a staff may quickly lag behind in its knowledge and skills. Systems consequently suffer. The networking technology is one of the newer aspects and requires expertise in both development and maintenance. Educational institutions increasingly are restricting travel budgets as other expenses surpass travel as a priority. Businesses may also be inclined to expend less funds; however, given the accountability required by their contractual arrangement and prevailing competitive environment, there is pressure to provide highly trained professionals.

Attitudes. One of the most important factors in realizing a partnership is the attitude of the data processing professionals, especially the director. Within education, there is a tendency on the part of data processing directors to view with suspicion external entities, especially private ones. Businesses also may have staff who do not hold in high esteem their counterparts within education. Either of these attitudes will seriously jeopardize achieving a partnership.

User Satisfaction. The degree of success of data processing operations, whether in education or business, is the level of satisfaction of their users. Within education, data processing users will seek other sources if not satisfied; in business, customers will switch to other companies or assume the job themselves. Users are the measurement of success and the tool of accountability.

Administrative Support. Both entities need support from the highest levels of authority. In education, the president must lend support attitudinally and fiscally to any joint venture. The chief executive officer of a company likewise must value and support with resources the management and staff who provide services to educational institutions. Both the president and chief executive officer also establish and emanate expectations, values, and standards of performance.

Physical

The second category of variables includes those related to hardware, scope of networking, and institutional configuration.

Hardware. The extent, type, and location of hardware are all considerations. Within an institution, the location of its hardware may be a reflection of the degree of receptivity to networking. An assumption is made that the more dispersed an institution's hardware, the greater the likelihood of networking and cooperative arrangements. For businesses a key factor is compatibility and experience with the institution's hardware.

Scope of Networking. Paradigms one through eight depict stages of data processing including the emergence of networking. If this framework is applicable, it is less likely that an institution described as paradigm one would immediately move to eight than would seven. The attitudes, organizational structure, and hardware configuration of seven make the transition to eight a slight approximation rather than a dramatic shift. And as most would acknowledge, dramatic shifts are difficult to absorb within an institution.

Institutional Configuration. The extent to which an institution has multiple locations may also be a consideration. It is likely that there will be more willingness to participate in an external network if there has been an internal network. Geographic isolation on the other hand may reinforce a somewhat parochial attitude, depending of course on the mission of the institution and its location. While the same may not be as true for businesses, there is the infusion of new ideas and people that comes with multiple locations that may not be as extensive with a single location.

Financial

Three interrelated variables are financial: viability, commitment, and cost effectiveness.

Viability. Both education and business must examine these variables carefully. It is important that both be in a position of financial viability, for an institution to meet its obligations and for a company to continue to provide effective services. In recent years there have been both educational institutions and companies that have "gone under." For an educational institution, an examination of its budget, state level funding, capacity for tuition, and external funds is critical. For businesses, the profitability of the company, its market standing, and its rating all are indicators of viability.

Commitment. It is often stated that commitment is evident only if dollars are allocated. If so, educational institutions must review what proportion of the institution's budget is allocated to data processing. They must also look at the level of compensation allowed for data processing professionals. For businesses, it is important to know where the dollars are allocated to determine where the corporate philosophy is translated into action.

Cost Effectiveness. This variable may be one of the more critical ones for both education and industry. It may even be the one that leads to a cooperative venture. An institution must carefully analyze how its resources can be maximized and consider if the business community can do so better than the institution. A company has perhaps a stronger emphasis on this variable than an institution given the former's profit motive. It is incumbent on business to assure that the "effective" side of cost/effective is part of the arrangement.

Institutional/Corporate

Four variables will be discussed in this category: (1) leadership, (2) priorities, (3) perspective, and (4) orientation.

Leadership. While all the other variables are necessary, they are insufficient unless leadership is included. Leadership of an institution or a corporation instills an ideology that can foster or limit a partnership approach within a partnership. Without leadership neither will move forward and both will "watch" the future evolve.

Priorities. Information must be valued as a resource by an educational institution for it to compete with other resources. Once within the arena, its value in relation to other resources must be determined and supported. An institution must have information as a high priority to effect a successful partnership.

Perspective. An institution or a corporation may choose whether to look out the window. The ones who do become more knowledgeable, more likely to change, and most probable to succeed. For it is looking out and away that one's view is extended and perspective broadened. Then a role can be determined.

Orientation. Once perspective has broadened, action must proceed. Those institutions and corporations positioned for action are those who will not wait for the world to turn; they are the ones carrying out a new course. The passive ones will wait for times to change.

This concludes the discussion of variables; the paper focuses now on analysis.

Analysis

Framework

The basis for analysis will be an analogy used to explain in simple terms the principle used in laser technology. It is titled in this paper "merging rings." As most are aware, when a pebble is dropped in a pool of water waves emanate out in the form of rings. When a second pebble is dropped in proximity to the first, their rings may meet. If the crest of one ring collides with the trough of the other pebble's ring, both rings are dissipated or diffused. If, however, the crest of one pebble's ring meets the crest of the second pebble's, the rings join into one stronger than the two. When this analogy is applied to education/business partnerships, the following assumptions result:

(1) When a weak company (trough) works with a strong institution (crest) both are impacted negatively (dissipate).
(2) When a weak institution (trough) works with a strong company (crest) both are impacted negatively (dissipate).
(3) When a strong institution (crest) works with a strong company (crest) both are strengthened.

Application

Based upon the last assumption, it appears that a partnership between a company and an institution within a networking environment will succeed if both are strong and will succeed to a greater extent than either alone. The other assumptions imply that success is unlikely if one of the two is weak. Should these assumptions be correct, what characteristics best describe the weak and strong or trough and crest?

Combination One

This combination is a strong institution and a weak company. The four categories of variables are used to describe the combination. Within personnel resources the characteristic that will make an institution strong in a partnership is a positive attitude to a partnership by data processing personnel. The variable that will most likely weaken a company will be lack of expertise.

Within physical resources an institution will probably be strong in the partnership if its hardware and facilities are in extended, dispersed locations. The physical resource that will likely most weaken a company is unreliability of hardware.

Financially, a strong institution will have a commitment to data processing; a weak company will have overexpenditures. Finally, the institutional resource most conducive to a partnership is leadership; for a company the factor that will weaken it most is mismanagement.

Combination Two

For an institution to be weak, the following characteristics likely are present: personnel - insecurity; physical - sole source; financial - minimal commitment; and institutional - lack of leadership. The strong company in contrast will have the following characteristics: personnel - expertise; physical - state-of-the-art equipment; financial - cost effectiveness; and institutional - effective management.

In combinations one and two it is evident that one negative variable can alter a positive variable. For example, if a company's staff has expertise but an institution's staff is insecure, it is unlikely that they can work together effectively. Or, if a company manages effectively but there is no direction from the leadership of the institution, neither will progress. Further, if an institution has a financial commitment but a company incurs cost overruns, a continuing commitment is in jeopardy. And as a last example, if an institution has leadership but a company mismanages, the institution's goal will not be achieved. But what could it be like when a strong company joins with a strong institution?

Combination Three

With this combination, visualize the results of the following strengths: (1) an institution's data processing staff have a secure, positive attitude and the company has a highly trained staff; (2) the institution has extended and decentralized its locus and the company provides state-of-the-art hardware/software capability; (3) the institution has a financial commitment to data processing and the company is cost effective in providing services; and (4) the institution has strong leadership and the company is well managed. A network of the future, stronger than either could do alone, becomes a reality.

Summary

This paper has presented a framework based upon a succession of paradigms used to explain various stages of data processing. The initial paradigm was a single data processing operation and a single institution in one location. The final paradigm was a decentralized data processing operation networked to other institutions and joined to a corporation in a partnership.

Variables that effect the movement from one stage to another were discussed. They were categorized according to type of resources: personnel, physical, financial, and institutional.

Finally, a framework for analysis was presented and its resulting assumptions were applied to a partnership arrangement.

Conclusion

Several conclusions are set forth in this paper:

1. The data processing network of the future will include education/business partnerships.
2. Numerous factors must be considered when entering into a partnership.
3. The success of these partnerships is dependent upon the strength of the educational institution and the strength of the company.
4. The successful partnerships will achieve goals that exceed those of education alone.

Several observations should also be made at this point. First, the authors took many liberties in interpretation; stated generalizations not always applicable to individual situations; and set forth numerous assumptions. The intent, however, was not to present an empirically based study; rather, the intent was to "look out the window," so that vision is extended and perspective broadened. The methodology itself was based upon the use of a paradigm. If observations arose that contradicted or did not "fit within" the reader's paradigm or framework of thought, the reader will begin to experience paradigm shift. Once on his/her own, new insights will emerge and a new paradigm will crystalize that "includes the old as partial truth...while allowing things to work in new ways as well...it throws open doors and windows for new exploration."

Footnotes:

[1] Marilyn Ferguson, The Aquarian Conspiracy (Los Angeles: Tarcher, 1980) p. 26.

[2] Marilyn Ferguson, The Aquarian Conspiracy (Los Angeles: Tarcher, 1980) p. 27.

TYING DIVERSE STUDENT AND ADMINISTRATIVE DATA BASES TOGETHER

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Postsecondary education, over the past several decades, has instituted automated data bases for very specific reasons. Student-oriented data bases were developed for admissions and records, for housing, for payment of fees and other receivables, and lately for the handling of student financial aid. These are in addition to administrative data bases for payroll, accounting, and accounts payable. All of these data bases, originally independent of each other, carry at least some data which should be available to all segments of the institution.

Redundancy and duplication of data exists in these data bases. The administrative costs associated with maintaining those separate data systems are often unnecessary, and adequate reports are almost impossible to secure. Technology is not being used to its best advantage; rather, the fragmentation caused by multiple data bases is working against cost-effective administration.

To solve the problems of tying separate data bases together, an institution must consciously seek to solve the political, emotional, and technical issues involved. Not only is adequate planning required, but cooperation coupled with strong administrative support is necessary. Institutions undertaking the interfacing of separate data bases need to understand the various pitfalls and road blocks before writing a single line of interface code. This paper offers general guidelines to institutions seeking to interface together their diverse student and administrative data bases.

Computerization in American postsecondary education has turned a corner. No longer do we talk about the wisdom of whether or not to computerize or even to research the benefits of computerization. Today, with the proliferation of data bases not only on institutional mainframes but also now on mini- and micro-computers, we are beginning to attempt to tie diverse data bases together. While our discussion will center on the area of tying student and adminstrative data bases together, the problems and challenges encountered in this area can be generalized to other areas of the institution where more than a single data base exists.

Those of you contemplating the attempt to tie diverse data bases together should remember a short poem by Lewis Carroll entitled, "How Doth the Little Crocodile."

How doth the little crocodile
Improve his shining tail,
And pour the waters of the Nile
On every golden scale!

How cheerfully he seems to grin,
How neatly he spreads his claws
And welcomes little fishes in
With gently smiling jaws!

Those who seek to bring order out of data base turmoil will be much like Carroll's little fishes swimming into the smiling jaws of the crocodile. But fear not; those teeth may be avoided, but it will take planning, understanding, and a fair amount of suffering.

A. Introduction to the Problem

Before you or I can begin to solve the problem of sharing and transmitting data between diverse data bases, we first need to understand several key concepts -- the effective management of data from an institutional and a user point of view, the problems encountered by ownership of data, and the redundancy and duplication already exisiting in data bases. Before we begin to examine data base problems, let's explore these three areas.

1. Effective Management of Data from the Perspectives of the Institution and User

In a fantasy world, everyone in an institution (or for that matter, within even a single office) would completely share appropriate data with co-workers. Instead of "War Games" movies, we would find intra-institutional cooperation at a very high level. We would all work together for a perceived common good.

Obviously, this fantasy world is not the real world of institutions today. Individuals perceive the ownership of data as power which is rightfully theirs to dispense. Your deadlines and priorities often are meaningless to others outside your immediate sphere of influence.

In a much broader sense, what is determined to be good management of data for an institution may not be in the best interest of a user. Likewise, what may be perceived as good management for an office may not be in the best interest of the institution and/or user. Here we shall stop to define the term "user." We will use the term to describe any individual or group who collects, records or manipulates data. NOTE: This data may or may not be machine retrievable; it can be stored on a mainframe or on 3 X 5 cards.

Deciding how you will manage data for an institution is the first step in bringing a rational approach to the sharing of data. Before any institution should undertake the controlling of data, it should determine the rules of the game for institutional data management. Some of the key questions which an institution must ask itself are:

- What is the scope of data collected by this institution and in what form is the data stored?
- Which groups or individuals are responsible for the integrity of the data?
- Is it important to the institution that data be consistent when shared internally and externally?
- How accurate must this data be for it to be useful?

Only after an institution begins to understand its current data structure can it begin to undertake the appropriate sharing of data within the institution.

As part of this institutional data soul-searching, the role of the various users will become clear. It is the user, after all, who initiates the collection of data, records the data in some way, and communicates that data. The institution, as part of its own understanding of the data universe, must ask the users questions such as:

- Why is the data collected and how is it used?
- How is the data stored?
- Who else outside the primary user accesses the data and how often?
- Are there others who could utilize the data?

Once the institutional managers of data have completed a rather comprehensive review, not only of how the institution expects to manage data, but how users assist or hinder in that management of data, then planning may proceed.

2. Problems of Ownership of Data

Very early in any institution's data soul-searching process, the manager may find problems with one or more individuals who feel they "own" data. This feeling of ownership is not limited to office managers, it also includes clerks and secretaries who feel a certain sense of power because they control data. How many of you have found out that a rather seemingly trivial task cannot be carried out because someone is sick or on vacation? (How many decisions will have to wait for your return because you "own" certain data?)

You must not only recognize the problem of data ownership, but you must assist those who have that problem. You can begin to resolve the problem in a number of ways, some of which include:

a. Hold discussions with those who currently "own" the data. Reassure them that the loss of ownership will not result in layoffs or loss of authority, but. will result in increased responsibility in the data-sharing process.

b. Involve the data owners in problem-solving sessions whereby alternate ways of collecting and recording data are investigated and the needs of others to have access to the data are explained.

c. If all else fails, specific instructions from senior institutional officers that data is to be shared may be necessary, although this is the least effective way to encourage cooperation.

No single approach works every time for everyone involved with data ownership. Rather, the approach used with one user may involve many sub-approaches. It is quite clear, though, that ignoring the data ownership question in the early stages of the process will cause significant disruption later.

3. Redundancy and Duplication of Data Within the Institution

As part of its institutional review of data management, the managers must begin to understand the redundancy and duplication which already exists within the institution. While it is impossible for us to cover all possible examples of redundancy and duplication, a good example will aid you in starting to understand the scope of the problem. Let's use the very basic student demographic data of name, address, and phone number. If you answer the following questions you may be surprised at the bureaucratic tangle we put students and ourselves through for three seemingly simple items.

a. How many offices collect that data from prospective students and current students? In institutions without data base sharing, a student's address would have to be changed, manually or via data entry, in at least the following offices:

1) Admissions
2) Registrar
3) Financial Aid
4) Housing
5) Parking
6) Cashier/Business
7) Student Activities/Dean of Students
8) Student's selected college or school
9) Student's major or minor department
10) Development/Alumni

b. How many forms does a student have to complete to change one of the items?

c. How long does it take to notify others who use the data that a change has occurred?

d. How many people are involved with the changing of data, assuming all possible offices and departments receive notice of the change?

e. How long does it take all affected offices to completely change this data for a single student?

While a particular institution may have a longer or shorter list of involved offices, it is quite clear: **simple data is the hardest to keep current and requires the most manual effort to transmit and to maintain**. Additional types of demographic data (including grades, enrollment status, and graduation information) would each have its own list of users who need or think they need the data. While some data is only of interest to a single office, most student data is of interest to more than one office.

Redundancy of data increases costs, in both time and effort, for those who have to complete forms or maintain the data. It also causes excess data management costs for the institution. Whether those costs be for on-line or off-line storage or file folders and 3 X 5 cards, it is a duplication of "costs" in personnel time and material. In addition, reporting accuracy and consistency are most difficult to achieve with such a system. However, there are some institutionally defined legitimate reasons for the existence of duplicate data (e.g., operation of vendor written software). However, **the institution should eliminate the duplication of the updating of this data.**

B. Politics and Technology — Must Conflict Exist?

Technology, as we know it, is neither good nor evil in itself; rather, individuals give technology its "taint" of black or white. Likewise, politics can work for the betterment of the institution or can work against the institution. As part of researching the data-sharing problem, every policy maker must understand what is the proper blend of technology for that institution and what are the politics of that proper blend.

It is impossible to prescribe for every institution what level of technology is appropriate. Obviously, what is correct for one institution may be too little or too much for another institution. Rather, what we suggest - - no, we urge - - is that the institution develop a road map towards the appropriate usage of modern technology to solve the defined problem. As part of that planning, the institution must understand the politics which will foster or hinder that development. Politics here means a variety of things, including:

- Once the appropriate level of technology is determined to solve the problem, what resources are available to secure and support that level of technology?
- What is the level of acceptance/resistance to the achievement of the determined level of technology?
- To achieve the desired level of development, how much real support exists among the board of control, senior institutional administrators, middle- and lower-level managers, and support staff?

If the level of support both in dollars and in acceptability is not readily apparent, then additional support must be achieved in both areas before the data sharing project is undertaken. Attaining a higher level of technology will require a certain expenditure of human and financial resources; therefore, the institutional political attitude must be correct. Without the proper amount of both, setbacks, disillusionment, and failure probably will result. It is better not to undertake a project or to scale down the project before it is begun, rather than to face doubtful success.

C. Attacking the Problem

When any institution begins to attack the problem of sharing data, a number of postulates must be understood. They are:

- "Might" doesn't always make it work.
- Cooperation has pitfalls.
- Personal energy will only go so far.

"Might" or administrative support, even from the highest of the institutional offices, will not, in itself, make the project succeed. Without high level support it is doubtful the project can succeed; don't expect an edict from the President or Chancellor to be your ultimate weapon on which success rides.

Cooperation does have its own pitfalls. Since you must rely on others for their help, you can be lulled into a false sense of security early in the project. While at first people may seem to be cooperative, as the project continues on, some of these people may become threatened with the loss of power or by the heavy burden of labor required of them. Therefore, the managers of the project must be constantly monitoring the willingness of those involved in the project for items such as missed deadlines, the constant pointing out of problems (real or imagined), and over-extended caution by participants.

While it is necessary to have both the administrative support of "might" and the cooperative attitude of staff, it is equally important to have the personal dedication of a staff to carry out the project. This dedication must be understood both in human and emotional terms. While a committee may be charged with the responsibility of making the project succeed, our experience indicates that usually two or three people really do all the meaningful work.

The project will require the key staff to be tactful politicians and skilled technocrats who pick up where others fall short or fear to tread. It will require these individuals to convince, to lobby, and to work over-time to achieve the goal of the project. **Freedom from other duties for these key people is one additional price the institution must pay for success.**

D. The Role of Planning

A project of this magnitude, interfacing diverse data bases, cannot be undertaken without considerable planning at various abstract levels. Besides the institution's own design for managing data, the project will require a conceptual plan to determine what data is to be shared and how the sharing is to be accomplished. An integral part of this plan must be the institution's policy on security and privacy as it relates to computing.

The primary conceptual plan should be as inclusive as possible, utilizing the systems life cycle model or a similar planning technique. The conceptual model must encompass as many data source areas as possible. As new data areas are "discovered," the conceptual map should be modified. Upon conclusion of the project, the plan then reflects the project "as built" rather than as originally planned or conceived.

While the systems life cycle can be applied to a project involving only a single data base, it may also be utilized to link separate data bases. The cycle has five separate stages:

1. **Definition Phase** - In this phase you define in detail what you are trying to do with the system or process. You explain which parts of the process are already automated and to what extent, and which parts are currently done manually. As an important part of the definition phase, you explain who is involved with the process and to what extent. The definition phase is the most **critical** of all the phases because it is the foundation on which the entire remainder of the project is built.

   The definition phase normally will include statements on the cost of the current process and cost of the proposed process with any savings (or future cost avoidance) noted. Responsibilities are usually defined in the document and success is defined even before the process begins.

2. **Design Phase** - This phase builds on the information gathered in the definition phase. It refines the definition phase, and the proposed processes are written in more enhanced detail. Processes which will be changed are defined. As well, new pathways for moving information or data are determined. This phase must be completed before a single line of code is written, otherwise it is probable that significant errors may be made in the project. The design phase does not ensure the absence of all errors, rather it minimizes the number and probably the severity of the errors.

   As part of the Design Phase, the team must consider the consequences of the following:

   a. Real time update versus a batch update. Here you must consider just how important it is that data be 100% accurate at any given point in time. You should also decide over what time frame this degree of accuracy is required (e.g., twelve months or only on registration days).

   b. How necessary is it that the primary or secondary sources for data update their information immediately or every week, etc? You need to decide what are the critical data elements in the Design Phase and then find out just how often they are updated today. (You may be unpleasantly surprised with what you learn.)

   c. What will happen if one of the data bases is not available at "interface" time, especially if it is a real-time interface?

3. **Development Phase** - This phase involves either internally producing software or purchasing software from outside vendors. In the process of tying two or more data bases together, the development phase is often complicated by the following:

- The data bases have incompatible file structures.
- The data bases have different keys (e.g., name versus student number versus social security number).
- Data is defined differently in the data bases.

During the development phase, most such problems will be identified as the team attempts to move data from one system to another system.

If you have not up to this point reached the paradox of which system has the best data, it will confront you now. Obviously, the reason why you share data is to be able to have the **best** data available, but getting all the players in the game to agree on which data is the best (or who is the primary source for the data and who is supplementary) is difficult.

During development, you must answer the following questions for each item of data:

a. What is the best source of the data? The second best, etc.?

b. If the data element is blank, who can provide the information?

c. If a secondary source initially provides the data and the primary source can now provide the data, should the primary source overlay the information from the secondary source?

d. Should the data field be protected so only one data provider can update or modify the field?

e. What happens to unprotected fields if more than one data provider updates the field (e.g., one office changes the address and the next day someone else changes it back)?

f. Should the data field be unprotected for parts of the year and protected for other parts of the year?

g. Is everyone defining the data field the same way? An example would be the term enrolled - it probably means something entirely different to the admissions, financial aid, registrar, and business offices. You need to write a definition of each data element before you attempt to write your interface. Have all the game players agreed **in advance** on the meanings (overt and covert) of the data field?

h. How will you recover your data bases if one or more is damaged? What will happen if your major student file is unavailable for a day? Who will inform other users as to what they can or cannot do that day? How often will you back up on-line or batch processes?

The writing of the specifications for the interface will take considerably longer than will the actual coding.

4. **Test Phase** - This is the time to try to operate the interfaces in conjunction with the data bases in a test environment. Output reports should be shared with the team members and with the users. The testing procedures should be substantial enough to attempt to simulate the system's entire cycle. The testing phase should not be minimized. **Before putting an interface in production, we recommend a signed agreement from each of the team players/users that they have adequately tested the interface and are satisfied with its results.**

5. **Implementation** - This is really more than just putting an interface into production, it is a close monitoring of the interface for an extended period of time. Problems will arise and the team should be ready to deal with them. Depending on the severity of the problem, caution should be exercised so that any quick fixes do not complicate the problem even further. Fixes should go through the same test procedures as did the original interface. Once again, agreement should be reached before the fixes are implemented into the system.

E. Development of Documentation

As is obvious from our discussion concerning the system life cycle, the tying of data bases requires more written work than actual programming effort. In providing documentation for the whole, you should consider including the following:

1. Statement on what you are attempting to do and why
2. A data flow diagram
3. Your Design Phase document
4. Rules for the movement of data as "discovered" or identified in the Design and Development Phases
5. A data element dictionary or similar documentation
6. Suggested job streams and job control language
7. Critical scheduling information
8. Sample output
9. Coding forms, sample on-line screens, etc.
10. All error messages, and an explanation (including cause and resolution, if not obvious) of each.

The documentation should be of sufficient depth to be used for 1) the introduction of senior institutional administrators to the interface, 2) the training of current and new office staff, and 3) technical information for data processing staff. Obviously, the material necessary for a data entry clerk may be different from that given to an institutional president, but we recommend an overview of sufficient depth so either the clerk or the president is aware of the extent of the interface process. We also strongly recommend the ultimate user be involved in the development of the documentation.

F. Experiences of the University of Missouri in Tying Data Bases Together

Our presentation gives you tips on what to do or what to expect in tying data bases together. The reason we began tying data bases together was to solve a very difficult situation. We had, and still have, various offices which collect the same data from students, parents, and others. These offices report this data to the local press, the state government and federal agencies. It was very difficult to explain to the University President and campus Chancellors why similar data collected by various offices was almost always different.

We also became convinced we could eliminate students standing in line to repeat the same mechanical function by coordinating the updating of data. The vehicle which caused us to undertake this process in the first place was the purchase of a vendor produced software system for student financial aid.

Our student aid system is a gargantuan consumer of data. It feeds on data from other outside vendors, students, parents, other offices and data bases. We immediately faced a quandary - significant amounts of data are necessary for the process to begin and we have two ways to input the data - by hand or by some automated interface. If Missouri is similar to your institution, we are experiencing a financial crisis not expected to go away very soon. Therefore, we decided to undertake the coupling of data bases as the most economic of our choices, as well as the most timely and reliable. Currently all of our interfaces are batch processes.

We began with the most obvious interface - - that with our master student information system. This data base is managed a little differently by each campus, even though the data elements are defined consistently. We began by sitting back and deciding what data we needed, when it was available, and whether or not the data from our student information system was better or more accurate than our data in the student financial aid system. As you can imagine, the rules for this interface constitute a sizable document. Even after we were finished with testing and were in production, we still discovered errors, omissions, and misunderstandings.

If we learned anything with the first interface, it would be that no interface can be tested enough nor are the rules of the interface ever understood completely by all the players. Also, no interface remains completely static. We are constantly monitoring our interfaces watching for changes in the way data is inputted and changes in the way data is used.

Our second interface was with our Accounts Payable System, or the system to write checks. We undertook this interface to eliminate the hand typing of vouchers (or lists of requests for checks). This interface was really quite easy since the rules for the interface were established by the fiscal side, and they were rather stable. Transactions had to be in a certain format and anything else was rejected. Our only decision was what types of aid should go through the interface; and that debate still continues. In the future we expect to replace this interface with an interface to the Student Accounts Receivable System.

Our third interface seemed like a "piece of cake" - - it was to move College Work-Study earnings and non-federal student earnings into our student financial aid system. It seemed rather straightforward: our payroll system had its data in one form, it created payroll files at a set interval; therefore, we could easily read those files, match our student aid applicants up and transfer the data. Technically it is easy, but politically we opened a can of worms: never before did we have a realistic accounting of which student aid recipients were working for the University and how many dollars were involved. We did not know the size of the problem until we had written the interface. Now we know we have a number of student aid recipients who work for the University and who may be over-awarded.

A seemingly easy interface has opened a door that all agree needed to be opened. However, we were not prepared for what came out of the door. The simplistic design of the interface did not take into account the fact we were introducing significant amounts of new data into the system. We did not properly plan on handling this new data. We are now doing our retroactive homework with campus administrators on what the political effect will be on campus when you tell a student and a department that all on-campus work must stop for that student. Once again the simple interface has proved to be the most complex.

At the present time, we are in the process of beginning the following additional interfaces this year - an interface with the University's financial accounting system (general ledger) to report on actual expenditures for student aid in the area of other scholarships and fellowships, as well as any funds which have been "returned" to a given aid fund. We also expect to interface with our student loan system to create transactions it needs to set up long- and short-term loan borrowers. We are planning an interface with the housing system to accurately determine who lives on- or off-campus and a tentative automated feed to the Alumni system with information of interest for future development work.

We have found the interfacing of student and administrative data bases to be very interesting and challenging. As we interface more and more data systems, we find timing and cooperation most critical. Interfacing data systems solves some problems, but it creates a whole new set of challenges for the institution. We feel these new problems will and can be solved if we understand the people and processes used in moving data around an institution.

The University of Missouri system enrolls about 56,000 students on campuses in Columbia, Kansas City, Rolla, and St. Louis. Annually over 22,000 students receive about $80 million dollars in direct and indirect student financial aid. Over 33,000 students annually apply for financial aid.

G. What Is Success

In order to define success, an institution needs to evaluate its own "personality." What we consider success at the University of Missouri is probably different from what you consider success. Moving data around an institution manually is complex (as is evident by your campus mail system), and the complexity is magnified when you attempt to move the data electronically. You need to be realistic at the very first when you undertake the process of tying data bases together so you neither expect too much nor expect too little. However, it is better to be conservative in your statements of eventual success rather than to promise too much and be unable to deliver.

Even if one line of code is never written, the institution will benefit from having gone through the planning and evaluation exercise. The planning itself will bring to light areas which could and should share data.

The task to tie data bases together will require dedication and courage. We opened with a quote from Lewis Carroll, let's close with a quote from Jonathan Swift:

> "When a true genious appears in the world, you may know him by this sign: that the dunces are all in confederacy against him."

If you undertake the process, you may very well find quite a group in confederacy against you. However, you may encounter one of the most rewarding of all opportunities.

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Coping With Computing Success

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ABSTRACT

Iona College offers nine separate degrees in the CIS/MIS areas. Computer literacy has been mandated for all students. The College already possesses more than two million dollars worth of artifacts which it uses on both of its campuses. "The more you get the more you want" syndrome is already apparent. To capitalize on its current competitive advantage, the College must plan for even more service, more equipment and more personnel. It must do this with tighter budgets and severe competition for these dollars from other sectors of the collegiate community.

The College has planned to deal with the internal and external forces by setting budgetary guidelines and priorities which will enable the College to maintain its lead in computing, especially academic computing. This paper will detail what policies and priorities have been put in place. It will detail the manner in which decisions have been made and their impact on the ability of the College to deliver both administrative and academic computing to campuses which have developed insatiable appetites for computing.

While Iona has established a national reputation for its computing capability, the College faces current challenges and has conceived specific coping strategies for the future. This paper delineates the reasons the College has succeeded to date, the challenges it currently faces and the strategies conceived to cope with future computing needs. Iona's coping strategies can assist other institutions grappling with the multifarious issues associated with their campus computing environment.

Coping With Computing Success

Richard D. Breslin, Ph.D.

INTRODUCTION

Iona College is a comprehensive, liberal arts college educating more than 6,000 students annually in curricular offerings at both the undergraduate and graduate levels. The college has immersed itself in information processing technology for years and its history, successful track record and commitment to computing have brought both regional and national recognition to Iona. (Iona's inclusion as the comprehensive liberal arts institution in the Inter-University Consortium for Educational Computing is an indication of the college's national stature in computing.)

ELEMENTS OF COMPUTING SUCCESS

Iona College has achieved institutional "computing success" because several critical elements are in place. Administrative and technological leadership has been sustained over a number of years; appropriate computing facilities exist, i.e., enough mainframe power to support thousands of users through many terminals placed throughout the campus. The College has the ability to network personal computers and dial up facilities for home computer users are available. Sufficient software capability is on line; adequate support personnel to develop new academic and administrative systems are on the staff. The institution provides user services (documentation, seminars, consultation for users with special needs, acquiring and/or developing and providing special software packages requested by users, et cetera). Well developed computer oriented curricula at both the undergraduate and graduate levels are offered; a computer literacy program for all students has been implemented, the faculty are committed to using computing in their teaching and research activities at the College. These, then, are the critical components of "computing success" at Iona College.

Even though the institution possesses numerous computing strengths, it, nonetheless, faces current challenges. To meet these challenges it has conceived future oriented coping strategies to maintain the computing successes the College has enjoyed to date. It is clear to the institution that the strengths must be sustained, the challenges met and the coping strategies implemented to insure this continuing success. This paper details the strengths, challenges and future oriented coping strategies. The reader will note the extent to which these three elements are interrelated.

THE CURRENT ENVIRONMENT: STRENGTHS

Leadership, from the president, the academic vice president and vice president for finance, and from the director of the computer center, has been the critical factor in advancing computing at the institution. Stemming from this leadership has been an institutional commitment to computing, both academic and administrative. Iona College has manifested this commitment by the resources it has put into the hardware, software and personnel associated with information processing technology. Currently, computing consumes nearly 10% of the operating budget of the college.

The institution enjoys a sustained, established track record in computing. It began this process in 1966 and slowly but surely accelerated its involvement in computing by the acquisition of hardware and software, the hiring of key personnel and the introduction of nine separate degree programs in computer related fields at both the undergraduate and graduate levels.

To foster this programmatic development, the college has expended its own funds through a faculty enrichment program designed to enhance the capabilities of our faculty in computing activities. The largest part of the $100,000 annual budget for faculty enrichment is driven to support such activities as tuition for those seeking degrees in computing, release time for study and curriculum development and the acquisition of personal computers, et cetera.

The philosophical underpinning of the College is its liberal arts tradition, and the institution has not wavered from the pursuit of its liberal arts heritage. However, it has recognized the necessity of wedding new technology to its liberal arts components. All students must study not only the traditional courses in the humanities and social sciences but also science, technology, mathematics and computers. It is also our basic philosophy that all disciplines, wherever appropriate, be taught from a computer based perspective. To foster this, the college has put in place a program entitled "Fellows in Science and Technology" wherein faculty outside of the science and computing disciplines become thoroughly involved in understanding matters germane to science, technology and computing. These faculty are responsible for introducing their newly acquired knowledge into courses they teach in their academic fields. Under these conditions, there is an environmental receptivity to computing. Information technology now permeates the community.

To support the educational programs, the computer center staff has developed innovative educational applications, for example, front end interactive preprocessors and mainframe look-alikes. Moreover, the staff has produced a series of high quality user publications which have proven to be a critical element in Iona's success. Iona's computer manuals deal with general systems, discipline and subject systems and programming languages. Additionally, the center has conceived an excellent long range master plan for computing activities. Nonetheless, a presidential task force is currently functioning to examine all computer related activities, functions and programs to plot out options and priorities for the future.

These strengths have generated a high visibility profile for the college as it has received both regional and national recognition for its achievements in and its commitment to computing. What has been done to date augers well for the future, but the successes have also generated a number of significant challenges.

THE CURRENT CHALLENGES

Computing is still labor intensive and the pressures to develop new programs, teach additional courses, provide new services and plan effectively for the future can produce both faculty and administrative burnout. There is a genuine danger of this occurring and means must be taken to relieve some of the pressures from the staff.

As successes occur and the academic community is even more "turned-on" to computing, the college is confronting the cry of "we want more": more programs, courses, services, hardware, software. The number of users has reached more than 4000 and their usage has tripled within a brief time span. New tools are required for the user population and this virtually mandates new hirings. As computing infiltrates curricular areas hitherto non-computer based, the college sees the necessity of improving faculty computer education and sustaining its program of faculty enrichment to provide assistance for those preparing to meet the needs of the computer revolution. There is virtually an insatiable appetite that once whetted does not wish to be told that "enough is enough."

Environmental impact studies have become very important to the institution as there is clearly a ripple effect for any new computer related activity. Thus, the institution must find better ways to understand the total impact of new computing activities on such cost centers as the computing center itself, teaching faculty, plant and property, the library and communications systems.

The challenge of maintaining the college's financial commitment to computing with an expanding fiscal base and competing demands on limited resources remains a highly debated issue. Additionally, it is clear that additional software is required as well as documentation for new user services. Matching personnel resources to increased demands coming from a variety of institutional constituencies is an ever-present problem.

Strengths and success have led to significant challenges. While addressing the challenges of today, Iona must at the same time prepare for tomorrow. Not to do so can cripple institutional response not only to current events but to those over the horizon. One thing remains constant: the future of computing is at one and the same time uncertain, promising and changing; the major current challenge is to provide for this uncertain future by building on strengths, responding to current challenges and developing future oriented coping strategies.

FUTURE ORIENTED COPING STRATEGIES

Iona has come to learn that planning is absolutely essential if current successes are to be maintained. This is particularly true of computing related activities because of the turbulence and constant change occurring in the field. To cope with modifications and changes in computing, Iona has deliberately looked to the future to implement an array of strategies that should enable the College to build on its present strengths and meet the challenges generated by the current computing and fiscal environment of the institution.

The strategies that the College is, and will be, implementing are numerous and most of them are not driven by new dollars. Considering that the College already spends a sizeable portion of its budget on computing, the institution recognizes that it cannot afford to supplement current computing expenditures with an infusion of significant new fiscal resources. While some of the strategies will call for some new resources, Iona has accepted the fact that "more money" cannot be the sole solution.

The college will establish a creative forum for technological futures. Stunning achievements have occurred in computing and the institution must be prepared to identify, plan and act upon innovative academic and administrative computing opportunities. Concomitantly, the college is currently engaged in strategic and normative planning (in contradistinction to tactical and operational); it is through this intensive planning period that the institution will choose its own future and lay out the new pathways for computing at the college. It is clear that computing will be central to our future. Consequently, all of our planning must be both realistic and synchronized so that the entire institution will be moving together. Once the College has clearly established the shape of its chosen future, the next step will be to develop adequate implementation strategies.

It has become clear to the college that it must develop a growth model which includes computer support requirements for all academic programs. To this end, the institution will conduct an internal environmental impact study for any new academic program under consideration. In the past, this has been done informally; the future will call for much greater formality in this regard.

As the institution has experienced exponential growth in its computing activities, it has not fully addressed some policy related issues; it will need to do so in the near future. It must, for instance, confront the question of the degree of financial commitment it will make to information processing technology. What percentage of its annual operating budget the College will expend on this technology and associated personnel remains an unanswered question, and one which must be resolved. A presidential task force is currently working on numerous issues associated with computing, and it will be the task force's responsibility to produce a series of computing related recommendations, including a percentage cap on computing expenditures.

Other policies that will have to be clarified must include a statement on mainframe usage (who can use it for what) and the role of personal computers within the computing environment. Greater emphasis will have to be placed on personal computer ownership, and the college will need to address the degree to which it will continue to support the acquisition of personal computers for faculty, administrators, staff and students. To date, the College has established strong communications networks. These will have to be enhanced as additional personal computers are added to the computing environment. The philosophy concerning this is that "everything must connect." The institution uses one purchasing agent for all computing acquisitions, and it will not modify this procedure.

The college has already learned the value of a wise use of its faculty enrichment funds; the institution, for the foreseeable future, will continue to drive funds to support faculty education in computing. Slowly but surely the college is transforming its learning environment through science, technology and computers, and the institution's program of "Fellows in Science and Technology" will be enhanced and enriched to buttress faculty awareness and education in information processing technology. Moreover, the institution will augment its current computer degree offerings by adding such degree programs as Technology Management (M.S.), Educational Computing (Ed.D.) and Telematics (B.A., M.A.).

To sustain the computing environment, both academically and administratively, the institution will commit itself both to the development and the acquisition of additional appropriate software. Additional innovative educational applications, similar to the mainframe look-alikes and front end interactive preprocessors, are examples of this activity. The primary reason for this will be the enhancement of our educational processes.

Because of its participation in the Inter-University Consortium for Educational Computing, Iona has committed itself to the development of educational software for the "high end" machine. The characteristics of this target machine are: one million bytes of memory; one million instructions per second; 1000 x 1000 pixel display; 32 bit architecture with virtual memory; high bandwidth communication between work stations; and bit mapped display capability. The software designed by Iona and other members of the consortium must be able to run on the target machine, and all software developed will be shared by consortium members.

It makes sense for institutions within and without the consortium to cooperate with each other, and Iona has committed itself to such cooperation as an institutional policy.

The college also recognizes the need to broaden its services to the community so that, to the extent possible, it can expand the community's understanding of this new technology. Concomitantly, the institution must also have a further reach out capacity to the corporate and foundation sectors through a high technology development officer. Funding is available, and this should be sought by someone with expertise in the field.

Additionally, the College must link all information centers, and this eventually will call for an organizational restructuring. Some additional personnel will have to be added to the staff and this will provide the opportunity for functional delineation of current and future personnel. At the same time, the college will attempt to reallocate faculty to academic computing activities. The end product of this should be the augmentation of user publications. User publications and technical bulletins will continue to play a pivotal part in Iona's computing success. Moreover, the college will need to upgrade and add additional hardware and move towards a paperless campus for information.

The future will produce multiple forces competing for limited resources. Within each camp there will be those who foster the mentality of "the more you get, the more you want" versus the mentality of "enough is enough." How much is enough may spell the difference between adequacy, obsolescence and state of the art. To the extent possible, Iona wishes to be at the state of the art. However, the institution clearly recognizes that it is only with strong commitment, sound policy formulation and adequate implementation strategies that it can be truly vibrant and hopeful of continued computing success.

The future oriented coping strategies outlined in this paper represent the institution's commitment to move forward and not be satisfied with previous successes. Within this context the overall future coping strategy will be that of flexibility so that the college can respond effectively to the various opportunities and challenges which will lie immediately ahead.

Decision Support: The End-User Finally Gets What He Wants

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This is a brief case history describing a situation in which two administrative areas of a College joined to outline a program for the resolution of a budgetary control problem which was confronting them. Adjunct instructional costs had been escalating but with the onset of City and State fiscal constraints it was essential that such costs be controlled. Only after most of the variables and formulas had been identified was the systems analyst called in. The data entry program used to construct the college's Master Course File accessed a table of approved instructional hours (previously determined as falling within budgetary limits) so as to reject sections which exceeded these hours.

Due to the excellent cooperation exhibited by the individuals involved a very efficient system has been developed which has the potential for even greater applicability.

I. Introduction

Whether we in the computer business like it or not, the user of computer services has finally caught up with us and is demanding his rights as an equal partner. The days of substituting our perception of his ideas for his real needs are numbered. The user's general dissatisfaction with the performance of computer support led to his doing something about it. With the availability of microcomputers and their companion the spread sheet modeling tool, the user can purchase his own computer support. Or at least thinks he can. The inefficiency of the final system no longer stands in the way of his doing what he wants to do. And if the value of the output is not always cost justified it doesn't really matter so long as that support is what he needs to get the job done. The user strives for equal rights.

Our college, N.Y.C. Technical College, is a conservative institution where change comes about with great difficulty. It's an institution that rarely looks beyond its walls for solutions to problems. It is quite content to attempt to resolve its own problems even if this means sometimes reinventing the wheel.

Did we experience "decision support"? It's hard to say. Our intent was to do some good old-fashioned systems development which would include the user from the beginning and keep him involved throughout the development cycle. Decision Support? It seems computer people have always been supporting the decision-making process. The only question has been the quality and sensitivity of that support.

So from a computer point of view, let's set the scene which our management players are about to enter. The track record of our computer people was not good. Often they had gone ahead and developed systems without knowing exactly what the user had in mind. Their justification was that the user really didn't know what he wanted but, he wanted something. So why not go ahead and develop a system based on what we the computer experts thought was wanted? Once the system has been delivered, there is time to make changes to satisfy the user's needs. Let him use the system which "doesn't do what he wants" and he'll eventually realize what he does want. What a way to build credibility!

As to our communications with the user, we were more concerned with rapid, forward movement than listening to what the user wanted. We often started the design phase before completing the analysis. And when the user was slow to answer our questions, we eagerly provided the answers for him. Sometimes we didn't even bother to ask the questions. After all, wasn't a wrongly developed system better than no system at all? If we guessed right, then he'll have the system he

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ordered. If not, we'll merely change the system to meet his needs. Unfortunately some of the changes pointed up major structural defects in our system. Now we had the ultimate challenge: make the system do what it wasn't intended to do! Confidently we charged ahead patching the system to "make" it work. We were in our glory.

Looking back on it, how could such systems development have resulted in anything but an unfriendly, unpredictable and totally frustrating experience for the user. And our credibility? Could there be any?

II. THE PROBLEM

At the beginning of fiscal 1975 New York City was faced with a massive budget crisis which many of you may recall hearing and reading about. The city was tottering on the brink of bankruptcy. Since our school (at that time named New York City Community College) was funded by the City it was drawn into this fiscal quagmire by an initial cut of $2.2 million dollars to the college's operating budget. The budget director attempted to cope with this problem but was frustrated by the inflexible computerized budget system he had inherited. Characteristic of the situation during that period, users had not been consulted when the computer center created systems. As an example of this inflexibility, it took two hours to transfer a faculty member on the budget from one department to another. The system, therefore, was useless in being able to provide timely information for administrative decision making.

About that time, the budget director became aware of the capabilities of the rapidly growing field of telecommunications. As a dedicated professional, he proceeded to utilize his home telephone to hook into the main frame of the CUNY computer and began development of a more satisfactory system. Using a word processing language called Wylbur he created a flexible, internal cost-centered (departmental) budget system which continues to serve the college in good stead. More than thirty programs written in the Wylbur language can be run against the file to establish planning files or spread sheets. The system permits analysis and/or impact studies of budget reductions or personnel shifts.

A. Background and History

New York City Technical College is a two-year career-oriented unit of a large urban university (City University of New York). In July 1980 the State of New York assumed total responsibility for the fiscal support of the college rather than sharing the responsibility with the City of New York as had been the case previously. As a consequence, the name of the college was changed from New York City Community College to New York City Technical College. This change carried with it new constraints with respect to budget operations. It became apparent that the budget development process and budget control would have to become more computerized than had been the case up to that point. A major reason for this was that the state budget procedures severely limit the college's ability to transfer funds and/or personnel from one major purpose to another.

The particular area of concern for the presenters of this paper was the fact that the college's budget for adjunct (part time) instructional services invariably was exceeded. Whereas prior to 1980 it had been possible to compensate for these deficits via budget modifications, the newly imposed state restrictions made it mandatory that allocated amounts for adjunct services could not be overexpended.

So that the reader may have some appreciation of the magnitude of the overall operation, the following figures are provided:

1983/84 Total Operating Budget -----------------	$34,500,000
1983/84 Total Instructional Adjunct Budget -----	$ 3,200,000
Student Headcount (Fall 1983) ------------------	12,100
Full Time Equivalent Students (FTE) ------------	9,700
Number of Full Time Teaching Positions ---------	379
Number of Unique Adjunct Positions -------------	420
Number of Multiple Adjunct Positions -----------	181
Total Number of Sections Offered (Fall 1983) ---	2,350

Three other factors must be mentioned as integral components of the budget picture:

a) The Full Time Equivalent student count is directly proportional to the credits generated by the students; a sufficient number of sections must be provided to produce the targeted credits.

b) A tuition revenue figure is established by the State as an offset to the college's operating budget. Thus, a specific number of full time and part time students must be enrolled to generate this revenue.

c) A student-faculty ratio, based upon state-wide averages for each academic discipline, is used by the Budget Bureau to staff the college. Adequate enrollment in the sections being offered must be insured to maintain these ratios.

As part of the general background to our paper, it should be pointed out that the Office of Academic Affairs had been involved in some less than satisfactory situations with the college Computer Center. Some of the systems which had been implemented involving personnel records and other management information reports were often developed by Computer Center personnel with minimal or no involvement on the part of Academic Affairs.

B. Specific Problem

In the Fall 1982 the college expended 53% of its allocated budget for adjunct services while generating only 47% of its student credits. It was apparent that if the situation were repeated in the Spring semester we would be facing a potential budget deficit of $300,000. Part of the problem was that the final version of the Master Course (section) File contained more sections than had been authorized initially by the Office of Academic Affairs. During the hectic period of registration, when departments requested the opening of additional sections, it was impossible to monitor the financial impact of such newly added sections. It was assumed that other sections would be cancelled due to insufficient registration but such guesstimates were nebulous at best. To exacerbate this situation, the college operates under a contractual agreement with the union whereby an Adjunct Instructor who is assigned and reports to the first meeting of a class must be paid for the entire semester. Thus, even if a section were cancelled after the start of class, the college was obligated to pay the Instructor assigned. The recognition by the administration of the impending disaster led to a meeting at which the President directed the Dean of Instruction and the Director of the Budget to insure that the adjunct budget would not be overexpended.

It should be pointed out, in fairness, that planning had always taken place re the staffing and scheduling of the instructional program. The problem, essentially, was the lack of a controlling mechanism to insure that departments could not introduce more sections than the college could afford to pay for.

Another less critical but nevertheless significant contributor to the deficit situation was the amount of released time which departments assumed for themselves. Whereas primary responsibility for granting such released time lay within the purview of Academic Affairs, some departments arbitrarily took more than the authorized amount with resulting inflation of their adjunct budget.

The Budget Director and the Dean of Instruction, having been colleagues for many years, agreed to analyze the problem and to formulate solutions. Following extensive brainstorming discussions, these two individuals met with a representative of the College's Computer Center to specify their needs. The users decribed in considerable detail the specific components of the system which they envisioned. It was then left to the Computer center to translate and deliver an operational package according to the specifications.

C. Program Description

The proposed program was designated as APEF which stands for Academic Planning Echo Form. As seen by its developers, the program would integrate the following factors:

-The number of full time instructors available in each academic department

-The amount of released time assigned to these departments

-The potential service to be provided via grant funds or by other departments

-The projected targets (credit generation) required of each department

-The total number of instructional hours projected for each department

By calculating the net full time availability and subtracting this figure from the instructional hourly requirement, the number of adjunct hours could be determined. Using average hourly costs for each department, an estimate of the department's adjunct instructional budget could be calculated.

Figure 1 (page 8) presents a simplified flowchart of the APEF system. In essence a historic record is used to project anticipated needs (credits and instructional hours) for a forthcoming semester. This information is transmitted to academic departments for their review. The departmental requested modifications are studied by the Dean of Instruction for conformity to College policy but more importantly to insure that the overall costs of the adjunct hours being requested are within budgetary limits and when approved establish the "maximum hours control". These approved "echo" forms are returned to the departments so that they may make specific adjustments to the "historic" file to bring it within the hourly limitations assigned each department. So long as the changes which may be necessary due to student demand, faculty requests, etc. fall within approved maximums the department is free to adjust its schedule.

The APEF System was introduced for the Spring '83 Semester and performed quite well during its initial break in period. A minimum number of "bugs" were detected but these proved to be easily resolved. After making necessary adjustments the APEF program was used to project total annual adjunct costs for Fall '83 and Spring '84.

At the conclusion of the registration period for Fall '83 a "final" APEF projection was produced and compared with the actual figures for that semester. The results were most impressive as shown by the following table:

COMPARISON OF APEF PROJECTIONS WITH ACTUAL FIGURES - FALL 1983

	Projected	Actual
Total Instructional Hours	7,972	8,144
Full Time Available Hours	5,122	5,274
Adjunct Hours Required	2,850	2,870
Adjunct Cost	$1,536,155	$1,536,342

D. Program Outgrowths

While the introduction of APEF has apparently resolved a serious problem which had been plaguing the Office of Academic Affairs, it has, not unexpectedly, created new avenues towards the solution of related problems. This may be the most significant lesson to be learned from our involvement with personnel from our Computer Center. The old adage, "nothing succeeds like success", has been confirmed. For as we have gained confidence in what a properly analyzed and constructed program can do, so have we become more willing to turn to the computer for solving other management problems.

An example of what has been accomplished as an offshoot of APEF is our ability to now control enrollment in any specific section for which students are registering. Prior to Spring 1983 the "maximum class size" listed for a section merely signified a previously agreed upon number which should not be exceeded. In some instances, however, a department would overload a section and then insist that it be split in the interests of "maintaining educational standards". The unfortunate outcome of such action was an increase in adjunct costs.

We now have the ability to introduce computerized controls on class sizes, i.e., once an authorized enrollment is reached, the next registrant will receive a message on the terminal, "section closed", when he/she attempts to enroll. If the department requests special consideration for a student, it is possible to override the controls via an overtally card issued by the Office of Academic Affairs.

Furthermore, it is now possible to access via the terminal, in real time, the enrollment in any section or group of sections. In this way the office can be alerted to situations which may require the creation of additional sections. Using data from APEF, we know whether funds are available to permit such action.

In our enthusiasm, we created a system so "airtight" that it provided no flexibility whatsoever. Thus, if a department exceeded its projected allocation by even $1.00, not one more appointment card for adjunct personnel could be processed by the budget control office. This was unrealistic since the original departmental dollar allocations had been made based on average salary rates.

We have subsequently modified our control program from a departmental cost center focus to a college "bottom line". So long as we do not exceed the APEF total dollar projection, cards will be processed. Reconciliation and adjustments are done after the fact.

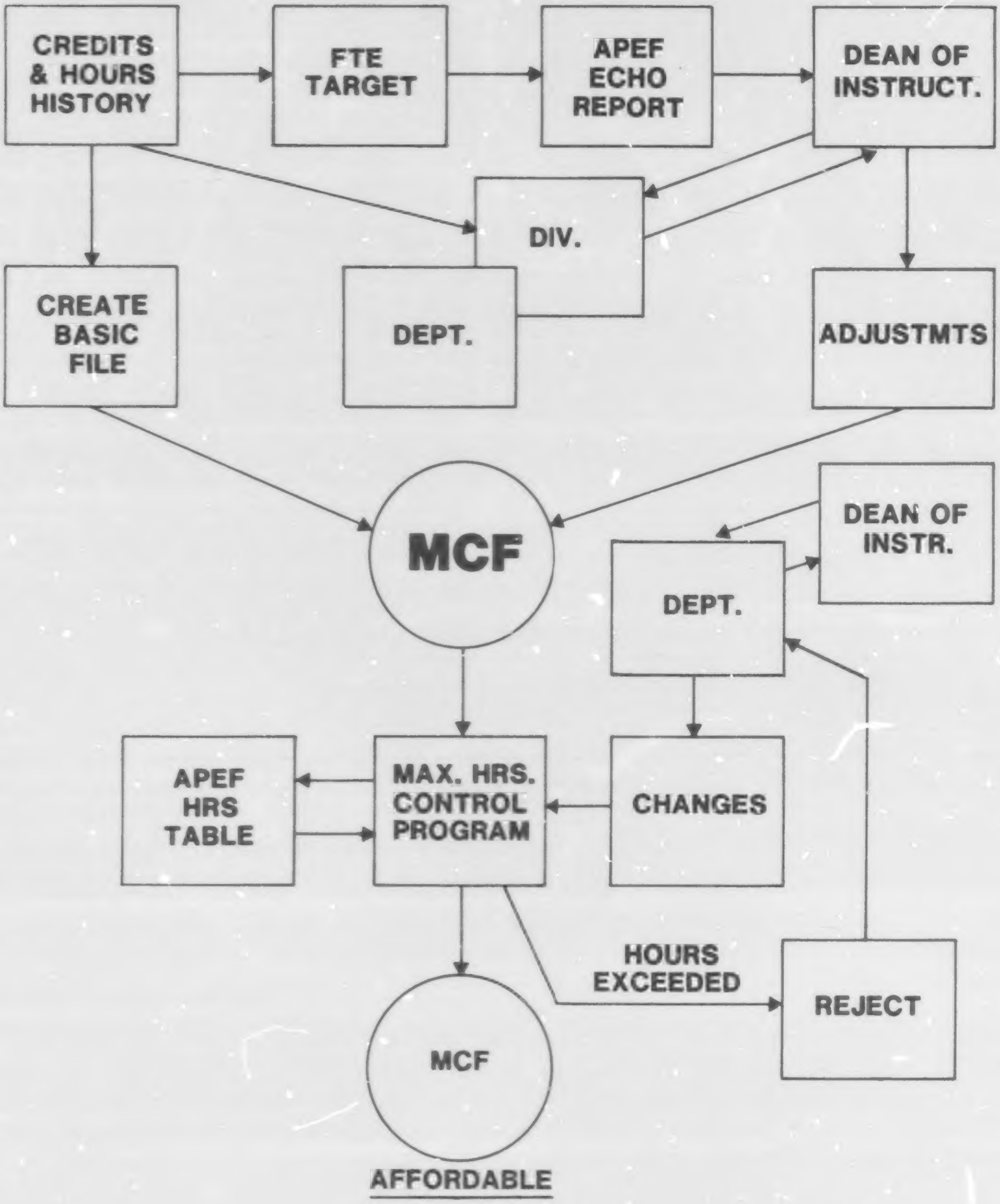
Based upon our success in developing the APEF program we are now ready to tackle more complicated problems. In this connection we have created tables of pre and co-requisites for all courses offered by the college. This will enable us to control student registration into these courses and hopefully improve our retention rate. Ultimately, we hope to apply historic data re student enrollment patterns to project our needs for specific numbers of sections on our Master Course File.

III. Conclusion

When the user knows what he wants and can provide concise logical specifications, he'll get what he wants. When the computer people receive, take the time to thoroughly analyze and understand these specifications, systems development stands a chance of success. Furthermore, when both sides can sit down together and, in a spirit of cooperation, understand exactly what the end result of the system should be, the chances of success are significantly increased.

FIGURE #1

CREATION OF AFFORDABLE MASTER COURSE FILE (MCF)


CREDITS & HOURS HISTORY
FTE TARGET
APEF ECHO REPORT
DEAN OF INSTRUCT.
DIV.
CREATE BASIC FILE
DEPT.
ADJUSTMTS
MCF
DEAN OF INSTR.
DEPT.
APEF HRS TABLE
MAX. HRS. CONTROL PROGRAM
CHANGES
HOURS EXCEEDED
REJECT
MCF
AFFORDABLE

TRACK II
Managing the Information Systems Resource

Coordinator:
Charlotte McGhee
John Grenzebach & Associates

M. Lewis Temares
University of Miami

Robert Little
University of Miami

The St. Francis
CAUSE

Robert Arns
University of Vermont

ORGANIZATIONAL RESTRUCTURING FOR BETTER INFORMATION RESOURCE MANAGEMENT

J. William Smith

and

William E. Groves

Medical University of South Carolina

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ABSTRACT

Like many institutions, the Medical University of South Carolina had several different non-linked computers serving different areas. To plan for optimal resource utilization, extensive interviews were held with high-level administrators throughout the institution to better define informational needs. Recommendations concerning resource management, software, and hardware were formulated to better meet stated requirements. To implement these recommendations, we revised our organizational structure. Rather than several computer centers under different directors, all operations now are managed by a single Department of Information Resources Management. The revised structure of this department, the planned computer and telecommunications architecture, and the current state of implementation of these projects will be described.

BACKGROUND

Until 1982, the development of computing resources at the Medical University of South Carolina had grown from a combination of two forces: 1) the recognition of the need to provide for the data processing requirements of administrative areas; and 2) the more individualistic requirements of faculty members and academic departments. There was no real perception of the need to anticipate needs, but instead, the University operated in an environment which most similarly reflected a free enterprise system distorted by readily available funds which allowed for the development of six computer installations, including Prime computers in the College of Dental Medicine, as well as the Departments of Medicine and Biometry, a Control Data System in the clinical laboratory area, a Digital Equipment system in the College of Pharmacy, and a Data General system in the Department of Family Medicine. Each of these systems was in an area reporting directly to the Vice President for Academic Affairs. In addition, the University's Computer Center, under the Vice President for Administration and Finance, operated an IBM 3033 system and associated equipment.

COMPUTERS AT MUSC

IBM 3033	Central Computing
Prime 750	Dental Medicine/Educational Services
Prime 550	Digital Equipment PDP 11 & 15
Prime 550	Biometry
Control Data 1734	Medicine
Data General C330	Laboratory Medicine
Family Medicine	Pharmacy

Although several of these systems performed well within their own areas, almost predictable problems began to surface. For example, there was almost no coordination or interface between the systems. Software development was left to the discretion of small users or was provided on a "what's available" rather than on a "what's needed" basis. Shrinking financial resources left operators of marginal systems in a situation where they competed for "business" to generate sufficient income to maintain operations.

To provide some coordination between the various computer operations, the University instituted a campus computer committee comprised of individuals with computer expertise from a variety of business and academic disciplines. This computer committee reported directly to the Vice President for Academic Affairs and was charged with the responsibility for planning efforts. Comprised primarily of suppliers of computer resources, the committee lacked detailed knowledge of University plans and was generally so divided in viewpoint that no single plan emerged for University computer operations. The situation was made more complex by the fact that one major computing resource was under one Vice President and the other lesser computing resources were under the direction of another Vice President.

ORGANIZATIONAL CHANGES

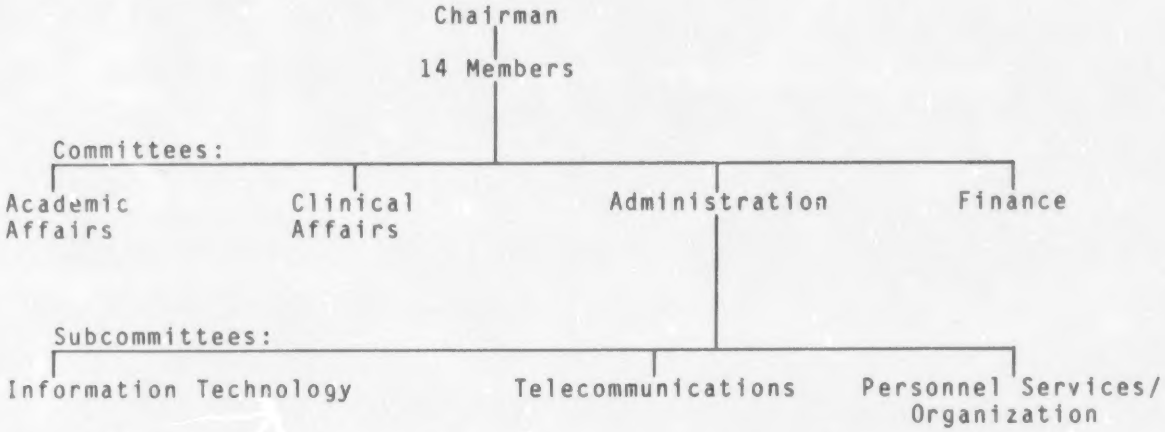
Approximately two years ago, the administrative structure of the Medical University underwent substantial change. One change that directly impacted upon computer operations was that the Office of the Vice President for Administration and Finance was abolished and two new positions were created, a Vice President for Administration and a Vice President for Finance. The management and coordination of all computing activities of the institution were assigned to the new Vice President for Administration. Under the new structure, a review of existing systems was initiated with a view towards reducing the number of operations and enhancing service to all segments of the University community. The early results of this initial effort led to a plan for the consolidation of work being accomplished on the three Prime computers and the integration of the surviving Prime 750 system into the Computer Center to be operated in juncture with the IBM mainframe.

About the time that the initial plan for the reorganization of University computer operations was completed, a new President took office at the University. One of the first things that the new President did was to establish a task force made up of business and industrial leaders from across the State to assist him and the vice presidents to identify ways to improve operations within the University. Emphasis was to be on the adoption of techniques and technologies that had proven to be successful in industry.

TASK FORCE

The Private Sector Task Force met initially in December of 1982 and formulated its purpose and methods of procedures. Its stated purpose was to review the management procedures as well as the overall situation of the Medical University. The ultimate aim was to recommend steps that could be taken to reduce costs and increase the efficiency of operations. A subcommittee of the task force was established to look at the overall application of information technology of the University with emphasis upon evaluating (1) systems planning, (2) institutional data management, processing and copying, and (3) existing systems. The Task Force was organized as shown on the following diagram:

PRIVATE SECTOR TASK FORCE


Chairman
14 Members
Committees:
Academic Affairs
Clinical Affairs
Administration
Finance
Subcommittees:
Information Technology
Telecommunications
Personnel Services/ Organization

Upon the completion of its assignment, the Information Technology Subcommittee, headed by Mr. George Langston, Vice President for Corporate Services, J.P. Stevens Co., Inc., recommended the following:

1. The University should develop and implement an information systems plan related to its strategic objectives and mission. This plan should:

   a) promote the use of dynamic technology
   b) provide for planning, organization, and control of information resources
   c) build better communications and working relationships between administrators and systems users; and
   d) provide the means for obtaining the commitment and involvement of management internally and the support from resources externally.

2. Information services at the Medical University should be organized into a broader-based function that would:

   a) be headed by a director reporting to the Vice President for Administration
   b) include all office automation and telecommunications, as well as computer operations, systems development and maintenance, and data management and administration
   c) consolidate and realign existing data processing functions to free personnel for work on new systems and to increase productivity
   d) assign systems development personnel by functional areas; i.e., clinical affairs, academic affairs, administration, finance, with each development group headed by an experienced project manager

e) form a special team to implement a patient care system, and
f) institute new data management, including planning and control.

3. A primary function of data management planning and control operations is to devise methods to ensure successful implementation of the acquired information systems. Four methodologies were recommended:

   a) a standard system development methodology based on pre-defined systems life cycles and quality assurance reviews
   b) management-by-objectives (Odiorne, 1979) to begin in the information services area and extend to all areas of the University
   c) project management and control to track systems development projects and schedule status reporting, and
   d) use of standard business systems planning (IBM Business Systems Planning, 1981) to complete development of the information system plan.

4. To establish proper overall control, an interim high-level management steering committee should be established that would:

   a) include the University president and four vice presidents
   b) guide and direct the development of new information systems
   c) set priorities over resources
   d) act as a sounding board for strategic issues, automated equipment selection, staffing, and operating policies
   e) meet as required, but not less than quarterly, until the University makes the full transition from computer management to data resource management when this steering committee would terminate
   f) deal with strategic rather than operational matters.

5. Major changes are required in the current operational systems of various Medical University computers. These changes should satisfy increasing demands for more timely, accurate, and complete information. Also, they should offset the critical need for maintenance and interfaces to exchange data and align hospital systems with University business objectives in anticipation of new regulations governing inpatient services and costs. Ultimately needed is a network of information systems and supporting data bases to provide an information resource function that would:

   a) be rationally designed and implemented similar to an architect's plan

b) be modular in concept, taking into account existing operational systems and needs to properly interface them until they are part of the network
c) have all data planned, managed, and controlled like any other university asset shared across organizational lines. (Association of American Medical Colleges (1982).

6. The task force administration committee made specific recommendations concerning the most needed information systems in the areas of patient care, education, research, finance, and administration. They noted that some of these systems are in place and should continue as is and some should be enhanced, replaced, or redeveloped into a new system. They further noted that the next phase in the development of these information systems should include specific requirements for each of the systems, including establishment of systems and data interrelationships. The interrelationships of education, patient care, and research involve systems that must be designed to meet overall university needs and complement the needs of other functions. Designs must eliminate fractionalized data files, inaccessible data, and inconsistent systems. Without duplicating functions, these systems must support the University's major divisions which are interdependent on shared data.

7. An office automation function should be established, reporting to the director of Information Resources Management, with authority to review and approve all office automation systems. A strategic office automation plan should be developed, along with the detailed plan for implementation of the word processing phase. Copying resources should be centralized through an implemented cost reduction program. All printing should be consolidated and placed under the administrative control of the Vice President for Administration. A computer-interfaced microfiche processor should be purchased and made available throughout the university.

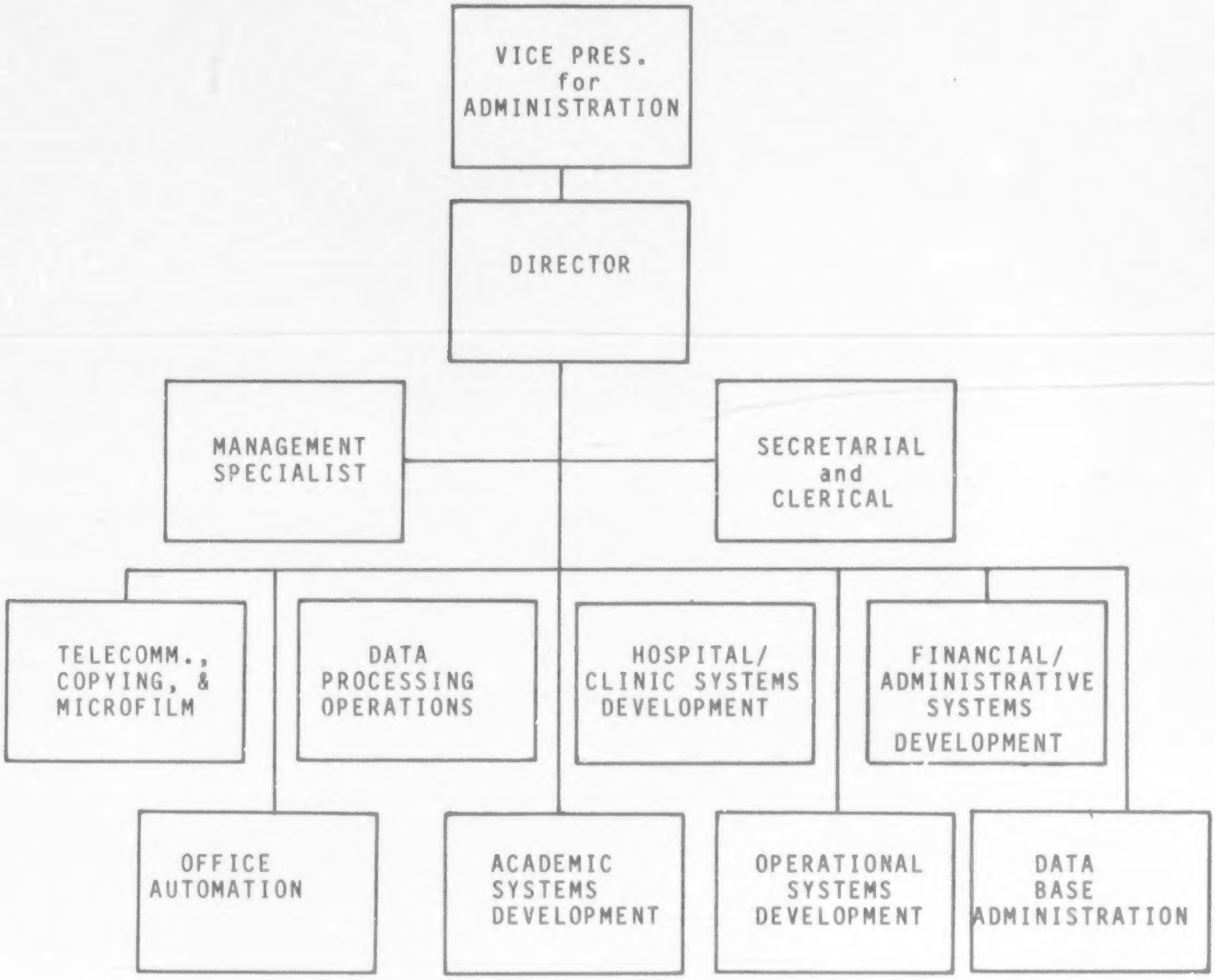
8. The existing centrex telephone system should be replaced with a modern electronic, private branch exchange. This computerized exchange should be able to support voice as well as data telecommunications.

The task force felt that existing Medical University computer hardware was sufficient to meet current and near-future needs but they recommended that work currently being performed on the Prime 550 computers be migrated to the Prime 750 computer and that work currently being performed on the Digital Equipment computers in the College of Pharmacy be relocated to the IBM 3033 computer. This proposed centralization of computer resources will make them available to a larger segment of potential users at lower cost. There also will be improved security of data and equipment, increased productivity of operational staff and equipment, and it will be possible to maintain integrity of existing software systems and applications while strategic plans are developed and implemented.

CURRENT ORGANIZATIONAL STRUCTURE

Based upon the task force recommendations and with the support of the Board of Trustees and the central Administration of the institution, in July of 1983 a Department of Information Resources Management (DIRM) was created and an acting director appointed. Since that time there have been shifts of existing personnel, as well as the creation of new positions, to accomplish the reorganization recommendations discussed above. Our current organizational structure is as follows:

INFORMATION RESOURCES MANAGEMENT


VICE PRES. for ADMINISTRATION
DIRECTOR
MANAGEMENT SPECIALIST
SECRETARIAL and CLERICAL
TELECOMM., COPYING, & MICROFILM
DATA PROCESSING OPERATIONS
HOSPITAL/ CLINIC SYSTEMS DEVELOPMENT
FINANCIAL/ ADMINISTRATIVE SYSTEMS DEVELOPMENT
OFFICE AUTOMATION
ACADEMIC SYSTEMS DEVELOPMENT
OPERATIONAL SYSTEMS DEVELOPMENT
DATA BASE ADMINISTRATION

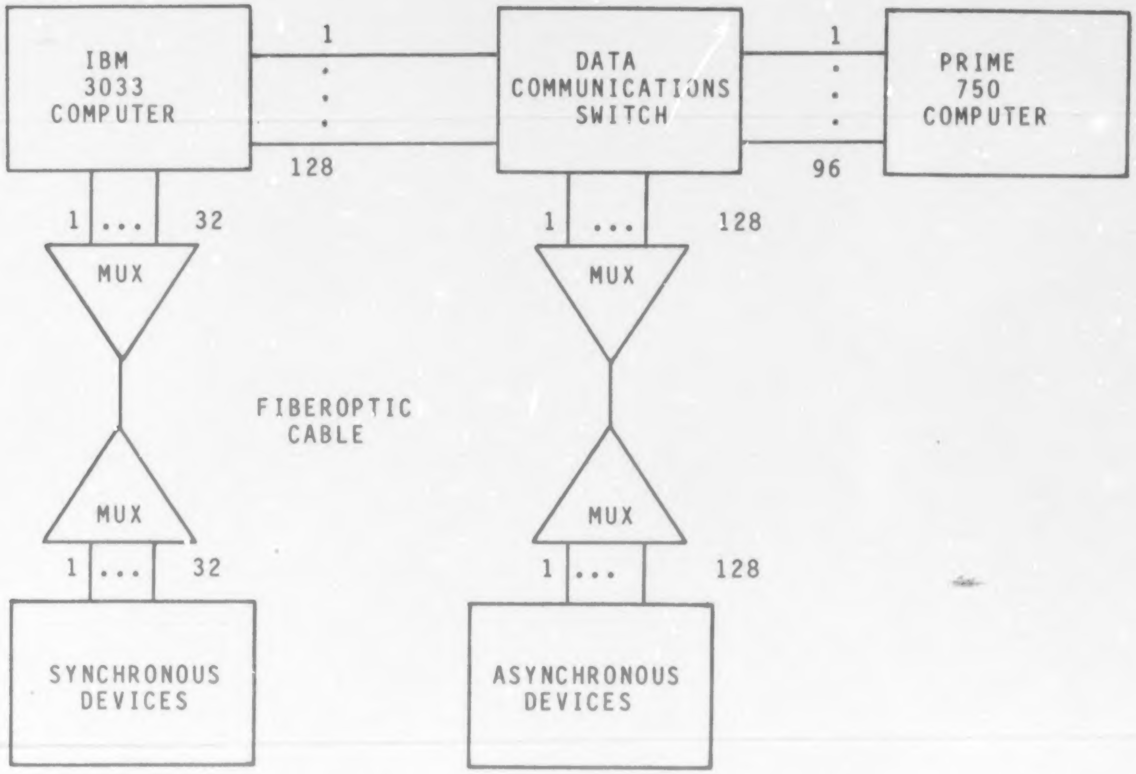
Specifically, a telecommunications, copying, and microfilming group now reports directly to the director of DIRM. Second, a manager of office automation systems position was created and filled. More recently the office automation efforts has been strengthened through the establishment of a training specialist position and the recruitment of an individual who works with users througnout the institution to assist them in fully utilizing their word processing and office automation equipment. Efforts also have moved forward to strengthen operations in the area of data base management and thereby prepare for a continuation of the information systems planning recommended by the task force. With regard to applications systems development, new higher-level managerial positions have been established in the academic, hospital/clinical, and financial/administrative areas, and individuals with training at the master's degree level will fill these jobs. For example, a manager of academic systems development already has been recruited and is working closely with the Vice President for Academic Affairs and the deans of the various colleges to review existing systems and prioritize efforts to change them or acquire new ones. Recruiting efforts are now underway to find comparable individuals for the Hospital/Clinical and Administrative/Financialtwo managerial applications systems development positions. At the present time a high percentage of effort in our applications software areas concerns maintenance of existing systems. A new managerial position to oversee operational software systems maintenance has been created and further restructuring of the DIRM organization will be necessary to implement this task force recommendation. The efforts of the above groups all are supported by centralized secretarial, clerical, and management specialist functions. By providing these latter individuals with office automation equipment as well as easy access to computerized information, relatively few individuals are able to support the many groups noted above.

More recently the Medical University has established an Office of Institutional Planning and Research which also reports directly to the Vice President for Administration, as does DIRM. This new office is working closely with DIRM in planning for systems to support university-wide academic and administrative needs.

CURRENT HARDWARE/SOFTWARE IMPLEMENTATION STATUS

To implement the hardware and software recommendations of the task force, DIRM is installing a University-wide fiber-optic cable network into all academic, clinical, and administrative areas. The following diagram depicts the proposed system:

CURRENT TELECOMMUNICATIONS PLAN


IBM
3033
COMPUTER
1
128
DATA
COMMUNICATIONS
SWITCH
1
96
PRIME
750
COMPUTER
1 ... 32
MUX
1 ... 128
MUX
FIBEROPTIC
CABLE
MUX
1 ... 32
MUX
1 ... 128
SYNCHRONOUS
DEVICES
ASYNCHRONOUS
DEVICES

At the user end of the network, the fiber optic cables will be terminated by multiplexors which will connect directly by coaxial or twisted-pair cable to workstations and printers. At the computer end of the network, the fiberoptic cables also will terminate with multiplexors which will then be connected through a data communications switch to controllers associated with either the IBM 3033 or Prime 750 computer. As recommended, DIRM will move the Prime 750 computer from its remote location in the University to a central location in the same area as the IBM 3033 computer. This will meet many of the recommendations of the task force with regard to consolidation and security of resources and will allow for better management of the software associated with these two systems. Because there are many asynchronous as well as synchronous workstations deployed throughout the University, DIRM currently is considering a data communications processor which would afford port selection/contention and protocol conversion capabilities. Such a device would be interposed between the Prime 750 and IBM 3033 computers. Users with asynchronous devices could then perform academic computing on the Prime 750 computer or office automation and other business functions on the IBM 3033 computer. At the present time the office automation group is working with staff throughout the institution to plan for acquisition of workstations which will be compatible with the network being installed. To this end in January we will begin installation of IBM's PROFS* system on our IBM 3033 computer for office automation. In anticipation of this we are acquiring numerous microcomputers. For example, recently our College of Pharmacy, working in conjunction with DIRM, has decided to replace its aging Digital Equipment computers with IBM PC XT microcomputers with associated hard-disk storage capability. This, too, fits into the pattern of recommendations of the task force since the College of Pharmacy will be able to interface these embedded-processor devices with the IBM 3033 system for downloading of data and transmission of documents as needed. In addition, several of the multiplexors and controllers associated with the fiberoptic cable network will be linked to 3278-type terminals (with attached light pens) for support of IBM's Patient Care System (PCS*) which currently is being installed. The patient management portions of this system will be available for use by hospital personnel in mid-January of 1984. To support the additional capability required to implement the task force recommendations, DIRM is installing additional memory on the IBM 3033 and Prime 750 computers and also is installing IBM's VM/SP* software product. This latter software enhancement is required as a prerequisite for IBM's PROFS* office automation system. The University also plans to obtain new commercially-packaged financial and personnel software. The rapid pace of recent events has been expedited because of our revised organizational structure.

ADDITIONAL CHANGES FOR THE NEAR FUTURE

Although many changes have been made in the organizational structure of DIRM since its inception six months ago, additional changes are still anticipated. First, the office automation group will probably continue to grow and develop, perhaps requiring the additional services of both a hardware maintenance engineer and one or more individuals who can assist users with the programming of their microcomputers. It may also be advisable to consider a closer organizational relationship between the office automation group and the telecommuncations, copying, and microfilming group since both of these activities are closely related to office efficiency. Second, much change yet must take place in the applications systems development area, in terms of personnel, reporting structures, and actual job involvement. Third, an operational systems maintenance group must be developed and training and responsibility for existing software shifted to that group. And finally, additional changes need to be made in the central management of DIRM such that the director has fewer people reporting directly to him but those who do must have both the expertise and authority to assume a wider range of responsibilities.

In the systems area many things still remain to be done. First, in the area of telecommunications much work remains to assure that individuals who wish to interface their equipment to the network can do so in the most efficient and cost effective manner. Second, the actual installation of the PROFS office automation system must yet be performed and training provided. Furthermore, to better support the new financial and personnel packages, the technical support group of DIRM will implement the MVS operating system, which is important to us not only to support these packages but also to allow us to prepare for a fourth-generation language for easier query capability and software development (Martin, 1982). Other major areas which will require extensive involvement of DIRM personnel in close support of users include the implementation of a computerized library system (Goldstein, 1983; Matheson and Cooper, 1982), the full implementation of the Patient Care System (Mishelevich and Van Slyke, 1980), and the replacement of our Shared Hospital Accounting System. We feel that each of these efforts will be expedited by the implementation of our new organizational structure.

While the efforts recommended by the task force are being implemented, new planning must be initiated to complement and augment those recommendations as we move forward into 1984 and the years beyond. In particular, detailed planning for integrated data bases will require much time and effort. Other benefits which will derive from this continued planning will be better standardization of our systems and better communication with users.

SUMMARY AND CONCLUSIONS

As the Medical University looks back over the last decade, there is little doubt that the progress which is now being made in the Information Resource Management area would not have been possible without the organizational restructuring discussed above. As noted by Synnott and Gruber (1981), the structure of the Information Resource Management function should mirror the structure of the institution. Now that this has occurred at the Medical University we are able to vigorously move forward toward the integration of our information resources for the benefit of all users. As a result of this restructuring, we feel we will be able to operate in a more productive and cost-effective manner.

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PLANNING FOR DISTRIBUTED SYSTEMS

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Waltham, MA 02254

Abstract

Most academic institutions have not devoted sufficient time and resources to information services planning. It is critical to do so now, both for financial advantages and long-term commitments needed to implement networks of distributed processing components. Some of the main motivating factors for distributed systems will first be discussed. Then methodologies and approaches from industry and academe will be contrasted to show how the processes of distributed systems planning and design can be effectively managed to meet a variety of institutional needs. Finally, issues and implications for the planning and design of distributed systems will be raised.

PLANNING FOR DISTRIBUTED SYSTEMS

A. Introduction

A variety of complex distributed information systems are now operational in many industries and financial organizations. These systems are comprised of multiple-vendor hardware and software components, private and public national networks, and local area networks supporting transaction processing and office automation activities using many data base management techniques. Some of these models have been well-planned and designed; most have been experiments or have just evolved as needs arose.

This industrial experience in planning and developing distributed systems can be adapted to the college and university environment. Whereas national or regional networks have been the basis for industrial distributed systems, the academic environment requires a local area network with interfaces to regional and national data resources.

Academic and administrative requirements for information systems suggest increasingly integrated technological solutions to: access a variety of computer-based resources, perform word processing, link thousands of student personal computers, transmit A/V to classrooms, and perform energy control and security monitoring of facilities.

B. Motivations for Distributed Systems

Let us first define what we mean by distributed systems. More than just an application utilizing multiple processors, the term "distributed systems" represents a natural evolution of the historic development of data processing, from its cycles between centralized and decentralized equipment and operations. During the past few years, distributed systems or "distributed data processing" has been evolving as a management philosophy and mode of operation in the large corporate financial and industrial information services organizations. Most of these organizations' information services activities are characterized by voluminous transactions that need to be processed quickly, accurately, reliably, and securely over a wide geographical area. A variety of advanced technologies including many levels of main frame, minicomputers, and microcomputer hardware, are integrated together by private and public networks, and managed by sophisticated software services to support corporate business requirements.

In the business world, this has meant cooperative data processing among computing equipment distributed among remote sites, distributed data collection, distributed data storage, distributed programming and maintenance, distributed operations, and distributed control over these resources. Corporations have, to a great extent, been forced to implement advanced concepts and technology involving computers and communications due primarily to business competition. They have been able to achieve some real measures of success in distributed processing because of centralized planning, tight controls, and a more focused mission than those of universities. Even though some excellent work in distributed systems has resulted from university theoretical and experimental studies, academic environments have lagged well behind the business world in large scale implementation on which day-to-day operations depend. The corporations have developed distributed systems for reasons of lower overall costs to provide flexible information services that can be adapted to and evolve in their business environments. Spreading the processing out among the users, taking advantage of inexpensive mini- and micro-computers, and saving costs by reducing on-line telecommunications between terminals and central computers are attractive to profit-oriented firms.

In contrast to these corporate motives, what are the primary factors pushing academic institutions to use distributed systems? Many of the same factors in the corporate business world (other than the profit motive) may apply to administrative functions in the college or university, although there is not normally as wide a geographical dispersion of college administrative computing users. However, potential instructional and research users of academic distributed systems are very different and pose many challenging problems and opportunities.

Robinson[1] described the desired and likely features for a contemporary 1990 campus network as including:

- "conformation to a world standard for transmission protocol, both electronic and syntatic;
- transmission of information entirely in digital form at rates well above 10 million bits per second;
- transmission of voice, video, and "data" simultaneously and support work stations using any combination of them;
- interconnection to more global networks (e.g., to EDUNET, etc.);
- redefinition of work place by providing access from an employee's home, a student's work place or residence, etc.

Such a network will permit vast changes in the way people interact with computers and the applications they implement. The ability to transmit large volumes of information (e.g., a whole book) in seconds will elminiate many past barriers to full information systems utilization."

And McCredie[2] gets to the heart of the academic motivation for distributed systems:

> "Creation, storage, retrieval, processing, use, and dissemination of information are at the core of

> academic effort. For this community, the convergence of computing and communication represents perhaps the most profound technical development since the invention of movable type and the modern printing press. Because information processing is so central to academics, systems that amplify human cognitive capabilities will have tremendous consequences, some of which are already visible in a few organizations."

Given the motivation and profound impact of distributed systems on organizations, how shall we plan for them? Three of the alternative approaches are:

1. Network. In this approach, the organization attempts to anticipate all communications requirements based on current operations and forecasted needs. See reference papers by Trinidad[3] of INA Corp., Kelley[4] of California State University, and Shipp[5] and Webber of Brown University.
2. Applications. New applications and existing applications requiring enhancements are subjected to some kinds of technological, managerial, and feasibility tests to determine if they are good candidates to operate within a distributed systems environment.
3. Master (or Organizational) Plan. This approach is viewed from the top-down, where the mission and objectives of the organization are used as the basis for a supportive information services and distributed systems plan. Normally better suited to the business corporation, this approach is increasingly being adopted by academic institutions.

C. An Industrial Distributed Systems Planning Methodology

There is a large body of literature in the form of books, periodicals, technical journals, and case studies describing distributed systems planning and design approaches and techniques. One such comprehensive up-to-date book is by the prolific James Martin[6], entitled Design and Strategy for DDP, which is oriented to the transaction-oriented business environment, but not as adaptable to an institution of higher education.

We shall now review a top-down, organizational, or master planning methodology prepared by the author for use in large, corporate information services in the business environment. This methodology also combines network and applications planning. The reader should then examine the possibility of its adoption to the academic environment.

Distributed systems (DS) planning, as defined here, begins at the point where distributed systems are recognized for their potential in providing greater amounts of local computing power, cost savings, and expanding the flexibility of user-oriented information systems. For the purpose of presentation, this methodology uses Yourdon[7]-style data flow diagrams to show the processes, inputs and outputs under study (see Figure 1). The five main modules are described below:

1. Identify DS Goals and Objectives. Analyze business and systems planning documents and current systems problems, along with the concepts and potential of DS to identify goals and objectives for taking advantage of DS technology and operations.

2. Determine DS Problems/Opportunities. Identify data/user environments where DS goals and objectives can be achieved. Identifies specific needs for planning and control in DS development and operation. Correlates "areas to manage" which are significant to specific data/user environments, defined in terms of how users interact with data. Examples may be:
    a. Integrated data base used by many user organizations,
    b. Independent data used by a focused user,
    c. Independent user using a shared data base.

   Based upon DS technology and DS management techniques identify system elements unique to DS and compare these to practices within the current system organization; this process identifies specific "areas to manage". These include hardware, system software, and network resources, in addition to application selection, development and maintenance. Managerial direction will then result in the definition of policies, procedures, and decisions which address DS technology and its management.

3. Apply DS Concepts and Technology. Analyze business systems planning documents to determine specific business applications where DS goals and objectives would prove beneficial in meeting business objectives. Correlate business applications (in terms of data and process requirements) with previously defined data/user environments.

4. Select DS Applications. Determine DS development and implementation strategies, apply DS selection criteria to business applications, map DS and migration capabilities to selected business applications for DS development based upon cost/benefit analysis, resources, and priority.

5. Apply DS Development Process. Develop and implement distributed information systems in a manner that maximizes service to the user community by way of a well organized and controlled system development process.

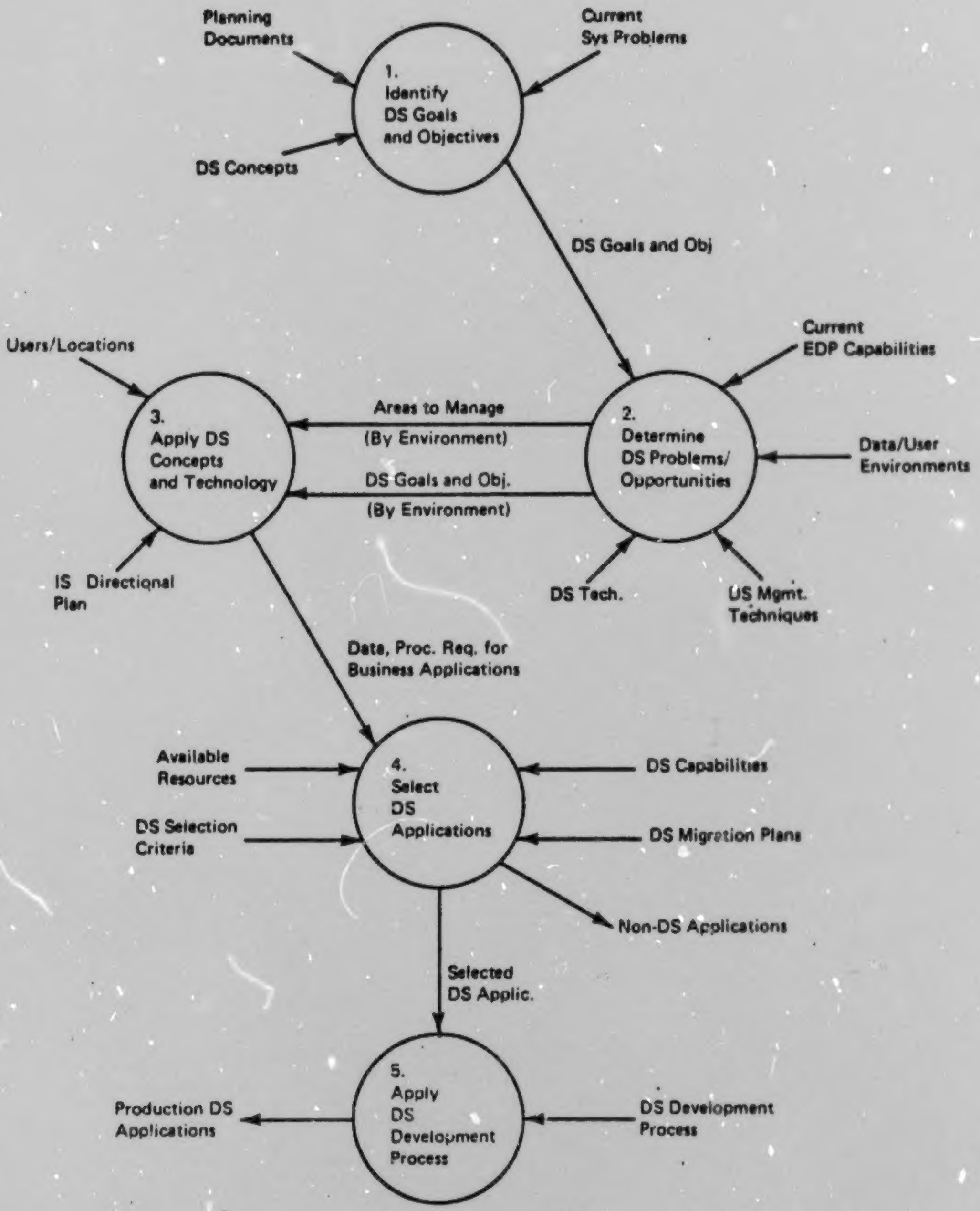
Planning Documents
Current Sys Problems
1. Identify DS Goals and Objectives
DS Concepts
DS Goals and Obj
Current EDP Capabilities
Users/Locations
Areas to Manage (By Environment)
3. Apply DS Concepts and Technology
2. Determine DS Problems/ Opportunities
Data/User Environments
DS Goals and Obj. (By Environment)
IS Directional Plan
DS Tech.
DS Mgmt. Techniques
Data, Proc. Req. for Business Applications
Available Resources
4. Select DS Applications
DS Capabilities
DS Selection Criteria
DS Migration Plans
Non-DS Applications
Selected DS Applic.
5. Apply DS Development Process
Production DS Applications
DS Development Process

Figure 1. Planning Methodology

To what extent could such a methodology be adapted to an academic institution, and if so, to what types of these institutions? Are some of the advanced distributed planning and developments in corporate business environments appropriate to the different nature of the academy? Is it a question of technology or organizational structure? Let's examine some of these questions by addressing three academic institutional planning approaches for communications and distributed processing.

D. Academic Distributed Systems Planning

More and more, colleges and universities are realizing the importance and necessity of strategic master planning for all of computer and information services. As has occurred in industry, vice presidents for information services and technology are now being installed in academic institutions. These positions represent the concept of information as a valued resource, and several functional units are being joined to provide planning, control, and resource optimization over such areas as computing, voice, data, and video communications, mail, media, printing, and library. Thus the computer center director who formerly administered two percent of the university budget, may now command (assuming he or she has the management skills and breadth for this challenging position) at least ten percent of the budget.

More formal approaches to planning are being employed to help provide the structure to integrate all these communications-based information services. Institutional goals and missions are being examined for alternative strategies. These possible strategies are then subjected to various feasibility tests, a strategy is selected, which is followed by shorter range tactical planning for realization of budget, resource, and scheduling implications.

Dartmouth College is an example of this move to master computing and communications planning. Arms[8] describes the movement from large centralized time-sharing to decentralized computing with planning by informal consensus. This worked well for academic computing but less well for administrative data processing. The president and provost established a Task Force on Computing in 1981 to advise on the following: academic computing, administrative data processing, library computing, word processing, financial control, organizational and management structure, and interactions between different areas of computing.

Kaufman[9] of Stanford describes the complex planning of information technology there, involving numerous administrative units and advisory committees. He also notes that there is much in the academic tradition that is antagonistic to formal planning. The best results come about through enterprise and cooperation rather than central edicts. But a framework is needed, rather than a neat, comprehensive planning process. "One of the most useful images for understanding the planning and use of information technologies at Stanford is a series of spheres of interest, some contained within others, some overlapping, and some not touching at all....These spheres of interest in some cases represent a general technological function, e.g., networking or data base management; or in other cases a specific, substantive interest, e.g., data about students, or teaching computer science." Although no master plan has been created to date, "the planning and management of information technology has evolved as a means of providing the University with knowledge of what is going on, criteria for understanding why certain things should or should not be done, and assistance in how things might actually get done."

My own institution, Bentley College, is now involved in distributed systems planning. Bentley is an independent, non-sectarian institution of 5500 full-time-equivalent undergraduate and graduate students, whose institutional mission is to produce the liberally-educated business professional. Long known for its strengths in the field of accountancy, Bentley has now assembled probably the largest business computer information systems faculty (25 full-time and 25 part-time) in the country.

As a smaller, less diverse institution than those mentioned above, Bentley is perhaps better able to plan for information services in a top-down, master approach. Last year the President[10] established an Information Services Steering/Planning Committee for these purposes:

"1. Direct and oversee the development of an information services long-range plan.

2. Serve as policy advisor to the President.

3. Report periodically findings and recommendations concerning institutional information services to the Computer Advisory Committee (of the Trustees) and the Council for Institutional Planning.

4. Review plans and budgets of the Computer Center and the Academic and Administrative Users Groups annually and to review the performance of theses bodies semiannually."

In addition to this top steering/planning committee with its two major subcommittees mentioned in 4. above for academic and administrative users, a third subcommittee (Campus Communications Committee) was formed last spring to specifically deal with all long-range communications related issues and to plan for integrated technologies. We are examining data, voice, and video needs campus-wide, as well as security, energy, library, and any other functions requiring communications both within the campus and interfacing to external information sources and destinations (i.e., regional and national computerized data bases, video instruction, etc.).

Thus Bentley is examining these questions:

1. Where are we as an institution, in terms of the College's mission, environment and current operations, with relation to and emphasis on information services?
2. Where do we want to go, in terms of mission, objectives and goals, and assumptions and risks?
3. How do we get there, in terms of strategies, policies, programs and projects, and management controls?
4. When will it be done and by whom, in terms of priorities and schedules, and organization and delegation?
5. How much will it cost, in terms of resource projections and operating budget?

Two significant recent events at Bentley as a result of this master planning are (1) the upgrading of the position of Computer Center Director to that of Vice President of Information Services, with significantly increased responsibilities, and (2) the installation of a pilot local area network as the first phase of an integrated communications network for the campus. The distributed systems methodology developed in industry and described in section C. is being considered by the author for use at Bentley.

E. Issues and Summary

As with any new technology, a number of technical and management issues are raised requiring problem resolution. Key technical issues include: data security, synchronization of data base updates, complexity of hardware and software systems, standardization of system architecture, and complexity of communications topology.

Management issues include: centralization versus decentralization of system design, implementation, management, and procurement of components in the distributed network, in addition to the need of local autonomy.

Finally, Clark[11] and Svobodova suggest that "...the fundamental issue is that computer systems should reflect the structure and needs of the problem to which they are being applied. The justification for distributed systems is that many applications are naturally distributed; it is the centralized computer facility that is often only the artifact of economic forces."

In summary, we have identified some of the main motivating factors for the movement to distributed systems, described planning approaches in industrial and in academic institutions, and finally raised some issues and implications of distributed systems that information services planners should consider.

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DATA CENTER TASKING

by

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Managing the information systems function has always been a dynamic, demanding challenge even in the tightly controlled, batch processing environment. Today with the advent of data base management systems, high level languages and most importantly, a rapidly growing population of knowledgeable users, the challenge is even greater. Integration demands an open, progressive approach to data center management that maintains the fine balance between being driven and driving. This paper is a discussion of data center tasking and presents a few ideas about organizing to accomplish those tasks.

I. INTRODUCTION

In the past, managing a data center involved providing processing capability for systems developed by an in-house applications programming group. Systems were invariably batch oriented and, although the processing steps required to execute an individual system might have been many and complex, the number of actions making demands on the computer system was usually limited to a few at any given time. Since all development was accomplished under the direction of the data center director, delimiters could and were placed on the demands to be made by an application system up on hardware resources. Further, since application systems development occurred on site, new system performance characteristics were usually determinable prior to actual system implementation. Finally, with on site development, programmer expertise was readily available when problems occurred. In fact, the data center operations staff derived its workload from in-house and, as such, was almost totally dependent on that source for guidance/support. Such is no longer the case.

With the advent of concepts such as packaged application systems, networking, end user computing and high level languages, the demands placed upon the data center by external entities have increased such that their impact will soon, if they have not already done so, greatly exceed the capabilities of the internal applications programming group. In addition, this impact can no longer be controlled as it was in the past, nor is it possible to get the "feel of a system" prior to implementation. This is especially true for servicing end user computing where workload requirements can be generated on an ad hoc basis. In this environment, the internal applications programming group has become but one of many users serviced by the data center operations group. Because of this, the data center is taking on characteristics of other than a commercial automated data processing services center.

While operations represents the prime area affected by the changing environment, it is but one aspect of the information systems organization (Data Center). Its inter-and intra-relationships cannot be intelligently discussed without directing attention to organizational strategy. Thus, before specifically discussing operations' tasking an understanding of data center organizational strategy is necessary.

II. ORGANIZATIONAL STRATEGY

The overall objective of an organizational strategy is to anticipate changes required within the data center organization in order to provide for the successful implementation of the University's mission. The strategy addresses the functions which should be performed by the data center, anticipates the specialized skills required, and addresses skills development, personnel retention factors and career pathing.

A. TARGET ORGANIZATION STRUCTURE

1. Original Organization

The original organization is depicted in Figure 1. The overall structure was divided into two major units, Academic/Research Systems and Administrative Systems. The Academic/Research unit was charged with supporting and advising the faculty and student user base, while all other functions were assigned to

ORIGINAL ORGANIZATIONAL CHART

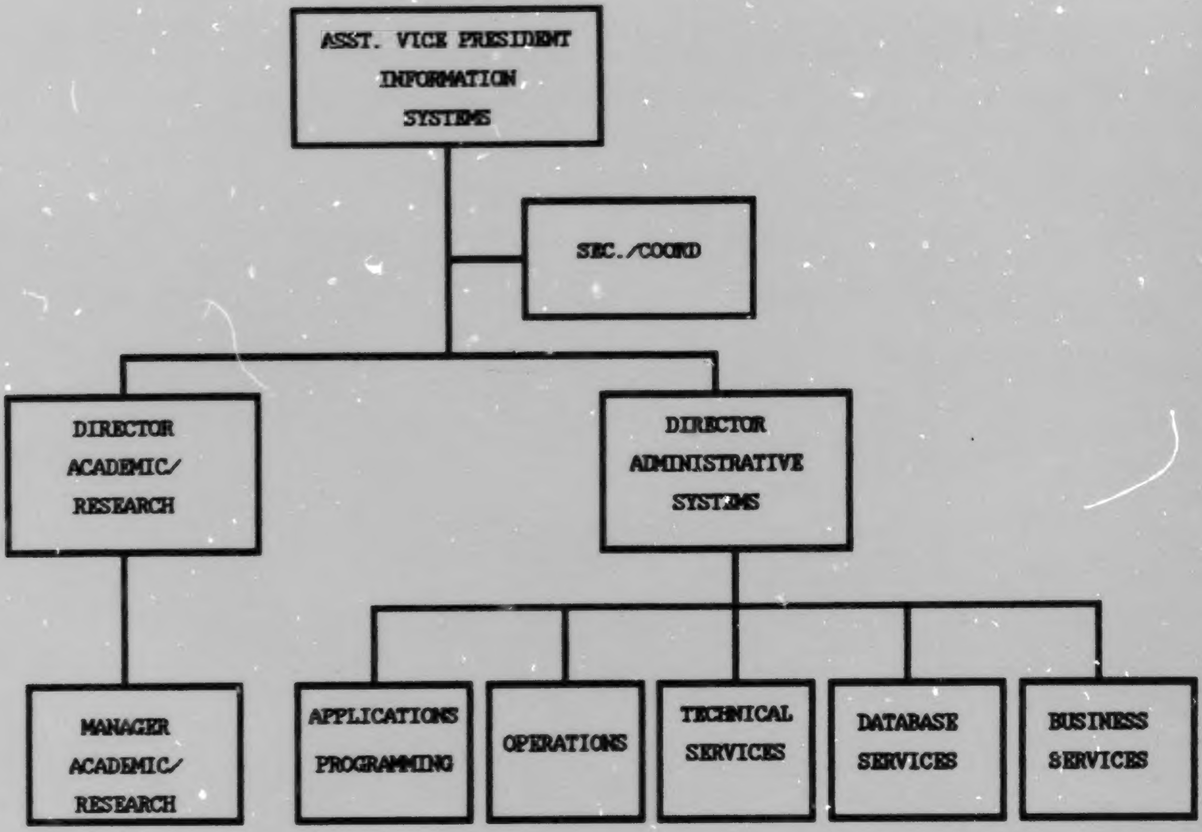
ASST. VICE PRESIDENT INFORMATION SYSTEMS
SEC./COORD
DIRECTOR ACADEMIC/ RESEARCH
DIRECTOR ADMINISTRATIVE SYSTEMS
MANAGER ACADEMIC/ RESEARCH
APPLICATIONS PROGRAMMING
OPERATIONS
TECHNICAL SERVICES
DATABASE SERVICES
BUSINESS SERVICES

FIGURE 1

the Administrative Systems unit. The departments which constituted Administrative Systems were as follows:

- Computer Operations
- Technical Services
- Data Base Services
- Systems & Programming
- Business Office

While, the Systems and Programming and Data Base Departments were oriented towards the administrative user group, the other groups served concurrently, both the academic and administrative communities. This created the appearance of a conflict of interest with respect to resource allocation.

Within the Systems and Programming department, the professional staff was divided between new system development projects and ongoing application system maintenance support. These dissimilar functions occasionally created competition for programming resources that sometimes caused serious delays in new project implementation.

Additionally, the original organization inadequately addressed the following functions:

- Security Administration
- Planning and Capacity Monitoring
- Quality Assurance
- Unit-wide Change Control & Problem Management
- Professional Development (training, career planning)
- Resource Management
- Office Automation Support
- Administrative End-user Computing Support

2. Revised Organization Structure

The revised organization is depicted in Figure 2. This structure attempts to rectify the problems outlined above by specifically providing for the functions inadequately addressed, and by recognizing that, inherently, data processing activities fall into the following categories of tasks which are:

- Project Oriented (long duration)
- Critical on a daily basis (including emergencies)
- Critical but not on a daily basis (including planning)

The new organization recognizes the significance of the resources to be committed to implementation of the University's plans and has isolated those project-oriented functions from the management of critical and non-critical daily functions. The classical data center functions, such as operations and technical support, are combined and managed by a director; the Academic and Research group remains unchanged and those functions which are critical but not on a daily basis are managed by another director. Additionally, the high investment and exposure of the implementation of new administrative application development calls for the full-time attention of a director.

The University of Miami is committed to the concurrent management of six new application development projects, an ambitious undertaking. Naturally, during this period of concentrated new development, existing applications must be maintained and kept functioning. The existing systems are batch-oriented,

REVISED ORGANIZATIONAL CHART

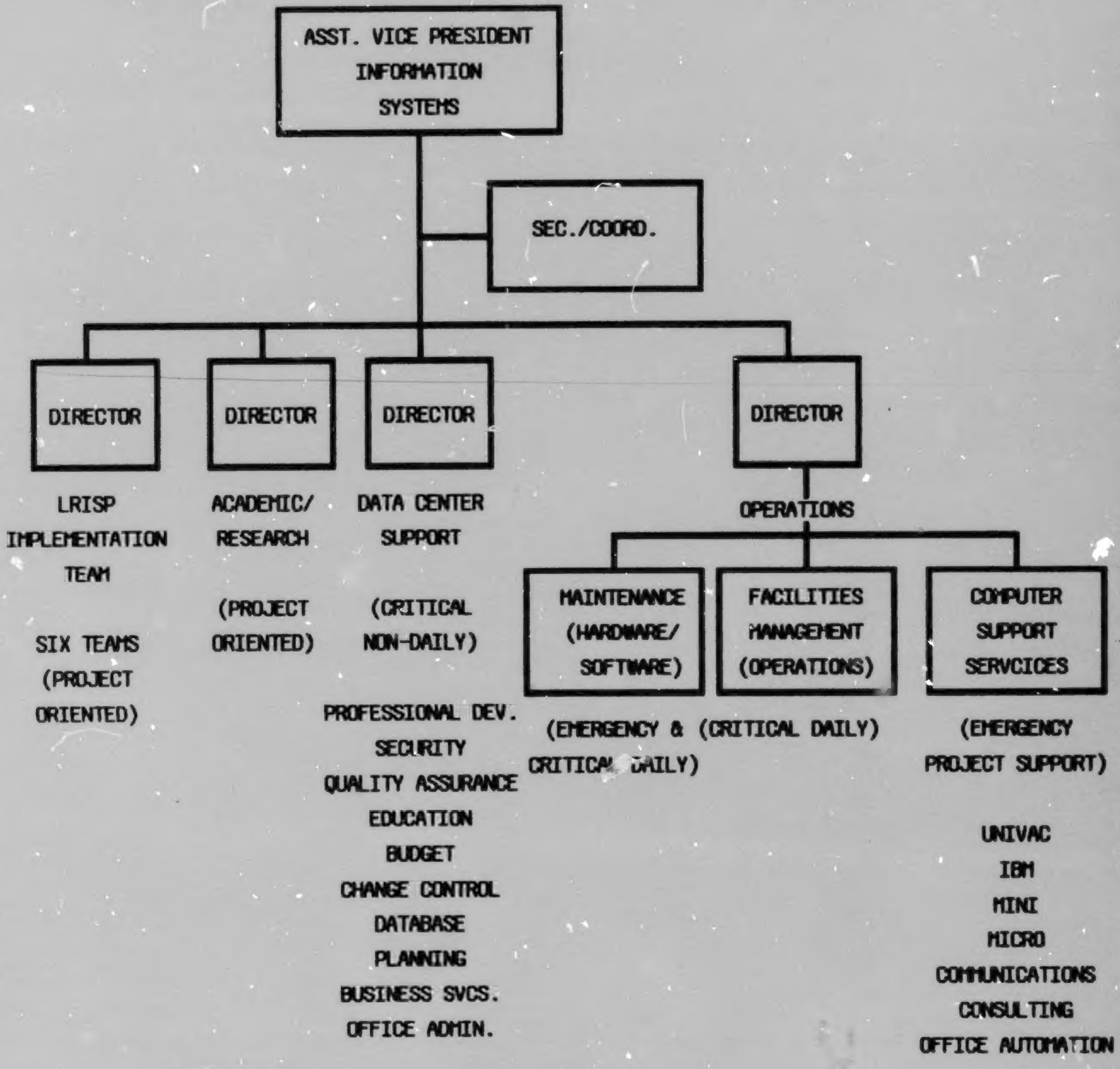
ASST. VICE PRESIDENT INFORMATION SYSTEMS
SEC./COORD.
DIRECTOR
DIRECTOR
DIRECTOR
DIRECTOR
LRISP IMPLEMENTATION TEAM
SIX TEAMS (PROJECT ORIENTED)
ACADEMIC/ RESEARCH
(PROJECT ORIENTED)
DATA CENTER SUPPORT
(CRITICAL NON-DAILY)
PROFESSIONAL DEV.
SECURITY
QUALITY ASSURANCE
EDUCATION
BUDGET
CHANGE CONTROL
DATABASE
PLANNING
BUSINESS SVCS.
OFFICE ADMIN.
OPERATIONS
MAINTENANCE (HARDWARE/ SOFTWARE)
(EMERGENCY & CRITICAL DAILY)
FACILITIES MANAGEMENT (OPERATIONS)
(CRITICAL DAILY)
COMPUTER SUPPORT SERVCICES
(EMERGENCY PROJECT SUPPORT)
UNIVAC
IBM
MINI
MICRO
COMMUNICATIONS
CONSULTING
OFFICE AUTOMATION

FIGURE 2

poorly documented, incorporate few automated controls, and utilize various inconsistent standards and conventions. Consequently, the operation and maintenance of these systems is very labor intensive. Batch technology requires scheduling, set-up, and verification of successful completion. Because data are passed from one application to another, additional batch interface jobs must be managed and manually controlled.

With the advent of on-line and data base technologies as well as an integrated approach, new application systems may now be designed and developed so as to minimize operation and maintenance costs. However, until the bulk of applications are implemented under this more cost-effective technology, the operation and maintenance of existing systems will remain labor intensive. The University has two incompatible main frames and temporary interfaces must be implemented to handle data passed between new applications on the IBM mainframe and old applications on the UNIVAC mainframe. This will place an even heavier demand upon data center's operations staff.

An increase in the number of personnel necessary to support the new development effort as well as operation and maintenance of existing labor-intensive systems is expected to be required for the next several years. After this period, personnel may be reassigned to perform functions resulting in increased levels of service. Thus, data center tasking has changed especially for the operations unit. A more detailed discussion of this change follows.

B. DATA CENTER-OPERATIONS

Data center operations must be organized and managed as an autonomous unit within the information systems structure. It must be capable of accomplishing all the tasks necessary to provide processing services regardless of the source. Specifically data center operations must provide an environment composed of four major subareas outlined in Figure (3).

1. Task Execution

Task execution involves those tasks normally associated with equipment operation and generally consists of providing equipment operators, managing the tape library, communications network monitoring and contacting vendor representatives in the case of equipment malfunction. The staff that accomplishes these tasks are usually shift workers and are event driven. As such, assigning projects beyond that which can be accomplished in a single shift should be avoided. This is not to say that their input into such projects should not be solicited and valued. Further, because the nature of the work requires immediate response to system messages, actions that divert the operator's attention for other than a very brief period of time should, by matter of policy, be referred to another group. This function is almost entirely internally oriented and communication with external units should be severely limited.

In brief, the area of task execution provides those capabilities associated with the operation of hardware in the support of executing systems. It is not a planning agency - it is a doing agency.

DATA CENTER TASKING

Operations Unit

Task Execution

- Primary Console Staffing
- Communications Network Monitoring
- Tape Management
- Peripheral Support Operations

(Providing the Operating Environment)

Production

- Service Level Agreements
- Workload Definition
- Scheduling
- Daily Capacity Optimization
- Input/Output Control
- Production Library Maintenance
- Job Execution
- Production Problem Determination and Restart

(Providing the Run Execution Environment)

Hardware Services

- Equipment Selection
- Contract Administration
- Operator Training
- Communication Network Management
- Facilities Security

(Providing the hardware environment)

Software Services and Management

- Maintenance Programming for current applications
- Operating System - Database - Data Communication Support
- General Package Support
- Software Security
- Secondary Storage Management
- Internal Standards Coordination
- System Monitoring and Tuning
- Internal Management Systems
- Consulting with users
- Office Automation Facilitating, Coordinating and Advising

(Providing the software and consultation environment)

Figure 3

2. Production

Production involves those tasks normally associated with workload definition, scheduling, job management and input/output control. This unit is the primary point of contact for matters dealing with processing systems and is the management group for all "production systems" - that is those systems for which the data center has accepted the responsibility for scheduling, setup, and execution. Unlike task execution, production goes beyond merely executing systems. Rather, tasking here is on two levels -- providing for runs/systems in the aggregate, and providing for individual run execution. This area is responsible for production systems from implementation through cancellation.

In summary, this area is the key to ensuring a successful production effort. The greater their success in executing endeavors, the fewer are the requirements for restart/recovery and massive periodic validation of documentation, programs, schedules, etc.. If well organized and controlled, the production environment can be an extremely stable, predictable environment of known dimensions.

3. Hardware Management

Hardware management involves those tasks normally associated with providing facilities, administering hardware contracts, managing equipment inventories, enforcing security and providing in-house operator training. As such, this activity is the primary point of contact for all matters dealing with the selection, placement, operation and maintenance of equipment. It is also responsible for operator training - including that associated with the physical communications network. Like the production area, this area provides a tactical planning capability as well as task execution. However, unlike the production area, this area is not primarily concerned with the processing environment, rather its interest spans all activities associated with data center operations.

In summary, the Hardware management group is concerned with a wide range of tasks by providing the hardware and a suitable environment for its operation. It is the manager of the information system's physical environment.

4. Software Management

Software Management involves activities in support of general use software, internal management systems, systems performance, secondary storage management, database-datacommunications, security, technical documentation and standards and user services. It also includes the facilitating, coordinating and advising for office automation. When used within this section, the term software included not only general purpose software such as operating systems, utilities, programming languages, database-datacommunications handlers, and internal data center applications (such as schedulers, system log reduction programs, help desk tracking systems, and the like); but, it also includes the day to day maintenance of current application systems.

The organizational structure has provided separately, outside of these areas, the nucleus of the data center planning group. There reside the data center change agents and there, also, reside the future character of the data center. However, had that not been done, these functions would occur here.

Software management must be future oriented, and if it becomes bogged down with reacting to daily problems, the center will lose its forward momentum. Thus, organizationally we have segmented out all non-emergency and daily critical functions such as planning, quality assurance, professional development and new application programming.

Systems software should be managed along the same lines as hardware. One does not even consider building his own hardware, and when procuring it, one ensures that specifications and a maintenance contract are available. In the same light, one should not procure a systems software package with the intent to modify it and provide maintenance internally. Operating systems, database-datacommunications systems, end user support packages, are just too numerous, too large and too complex for such a mode of operation. This also applies to purchased applications software packages, maintenance should be provided by the vendor, for as external requirements change (IRS, state regulations) so must the package.

III. SUMMARY

In summary, operations tasking should be as outlined in Figure (3). This tasking will provide data center operations management with a quanitifed understanding of system capacity as well as the present and future workloads. This will, in turn, permit the development of plans and schedules to meet current and emerging requirements. Further, it will permit the monitoring of system and user performance to ensure correctness of execution and adequacy of planning. Thus, the variance between that which was planned and actual occurrence can be closely monitored permitting early detection of adverse trends and timely development of effective countermeasures.

The knee jerking spasms that inevitable occur when the reactionary mode of management exists can be avoided by following the organization strategy delineated above. Data center management may then be proactive and take on the characteristics of a dynamic, aggressive, future oriented organization capable of addressing wide ranging requirements. This is mandatory if information systems is to appropriately address the challenges of today and tomorrow.

THE INFORMATION / DECISION SUPPORT CENTER

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Kalamazoo, Michigan

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ABSTRACT

Meeting a growing demand for administrative decision support, information center training and consulting services with a limited staff and budget presents a unique problem for the manager of administrative computing services. An organizational structure is required which can merge these two areas, maximize the productivity of the available staff, satisfy the user demands, and provide for necessary growth as the function matures.

As a part of an administrative planning effort, Western Michigan University conceived of a center in which both Information Center and Decision Support activities could be provided. This paper describes the experience of Western Michigan University in the design and implementation of a combined Information / Decision Support Center.

Introduction

This paper is a description of a combined information and decision support activity presently in operation at Western Michigan University. The paper begins with a brief review of the results of a university-wide planning effort for administrative computing services. A number of the outcomes of the planning activity suggested the need for information center and decision support type services.

The design of the center, a description of the services presently available, and a discussion of implementation techniques are the main components of the paper. The paper concludes with an evaluation of the current status of the center and several comments about its future.

Background

Western Michigan University is a state-supported institution serving approximately 18,000 full- and part-time students. The university offers graduate and undergraduate degree programs in the liberal arts and sciences, business, education, the health fields, and pre-professional disciplines.

Academic and administrative computing are provided through separate centers reporting to separate vice presidents. The administrative computing center houses an eight megabyte IBM 4341 group II. Approximately 100 devices are networked through a 3704/3272/3274 architecture. During the next eighteen months an on-line student information system will be installed. Significant upgrades to the network, the operating system, and most hardware capacities are planned. During the past twelve months the university entered into a long term computer resources management contract with Systems and Computer Technology Corporation (SCT).

Computer Services Plan

A five-year master plan for administrative computing has been prepared. The planning effort involved interviews with some 135 administrators representing each of the then 62 administrative units of the university. The plan was presented using a "needs/resources" concept: the university **needs** applications systems and services; **resources** required to prepare and maintain these systems and services are management, staffing, a physical facility, computing hardware, and computing operating systems.

The plan's outcomes were divided into three major outcomes:

- o Management Plan
- o Operating Support Plan
- o Applications Development Plan

Each of the above "sub plans" contains background data, current situational data, a needs analysis and a set of recommendations. A combination of needs from each of the three areas provided the impetus for a structure which would provide both information center and decision support services.

Needs

The needs which are briefly described in this section are a result of trends which exist in both user communities and in the computing industry. Users are becoming more literate in computing and are also becoming more involved in computing activities; the industry is producing more powerful general purpose microcomputers and more sophisticated batch and query productivity aids.

At Western Michigan University, these trends have manifested themselves in predictable ways. In the user community there is an increasing dependency on microcomputing and a growing need to have a micro/mainframe link. Users are involved in the use of batch report writers and desire a similar tool for real time access to university data bases. In the data center there is a need for productivity tools, a better way to support ad hoc reporting requirements, and a more formal structure for providing user education and consulting on both existing and future data center products.

Finally there is the need to respond to a growing applications backlog. A multiple year profile of manpower needs versus available manpower resources will, in almost every case, clearly demonstrate a need which is significantly greater than the available resources. This is also the case at Western Michigan University . The solutions to the dilemma are to either ignore the situation or help the university find alternative solutions to the problem within the constraints of both limited dollars and limited human resources.

These needs are part of a general evolution to more user centered data processing, an evolution that would have been called distributed data processing in the past. The problem is that supporting this evolution requires unique skills which are typically not available in the user community and frequently not available in data centers.

Why an Information/Decision Support Center?

The decision to create the center as a solution to the issues described above was not an obvious one. It was the result of evaluating several alternative solutions and finding each of them lacking in some significant way.

Simply adding additional programming staff to help reduce the backlogs could have helped but for two reasons: (1) there was no additional funding available to hire additional personnel and (2) the needs for user training and microcomputer support were equally as strong as the need for traditional systems development support. Clearly, a response was needed which would somehow address all of these needs in a comprehensive way.

Consideration was given to a plan which would more closely involve the users in the development and processing of their own requests by teaching them the use of a report-writing language. While the essence of this solution was attractive and was directed at a significant problem area vestiges of past experiences in this area suggested caution. In a previous drought of programming service several aggressive users had begun programming their own applications. They soon moved beyond producing reports and were creating intricate information systems which were fragile, undocumented, and impossible to maintain. Some effort to provide appropriate control and supervision would have to be found if this activity were to be encouraged again.

It was felt that continuing with the current system, or providing a minimal effort response due to lack of resources would jeapordize data processing's credibility and damage current and future development plans. It was also obvious that while some demands for application systems could be delayed, the user needs in the area of ad hoc reporting and microcomputing support would have to be addressed immediately.

The concept of a coordinated effort which would assist users to become more self-sufficient, and which would provide additional support to several areas not addressed by the traditional applications development process seemed to incorporate the good points of all the alternatives. This effort would be designed to maximize the effect on the users needs and to minimize the impact on the data processing staff. User education, consulting, microcomputing assistance, and support for ad hoc reporting and query would be the areas of focus.

The Design of the Center

The ultimate design of the center was in direct response to the outcomes of the long-range planning process. When the list of unmet user needs was compiled a group of requests stood out as not requiring traditional application development support. When this list of requests was evaluated three major categories of support emerged and became the central elements of the Center's mission. Below are outlined those three areas and the needs which they encompass.

Education and Consulting

- To provide users with instruction in the effective and efficient use of the data processing resource.
- To provide a resource for resolving problems that users experience with applications.

Decision Support

- To provide users with the tools to access and explore their data in their own way.
- To provide efficient response to ad hoc user requests for reports and information.

Microcomputing Support

- To assist users in defining the applicability of a microcomputer in their environment.
- To support users wishing to establish micro-to-mainframe communications.

Planning for the Center

Because the Center is a pilot project, it's resources are intentionally limited to the support of it's immediate first year goals. Future budget and resource allocations will depend upon the success of the pilot project.

Three full-time staff are assigned to the Center. They were chosen based on their skills and experiences related to the identified mission of the Center and on their demonstrated ability to work well with users. The manager has significant microcomputer, user training and systems analysis experience as well as a knowledge of the local report writer software. The two information specialists have individual strengths. One has considerable experience with systems analysis and user training and the other has operations experience and expert knowledge of the report writer software. One of the implied project goals is to cross-train all of the Center staff to a level of competence in each of the other staff member's strengths.

Hardware support for the Center initially consisted of existing terminals for each of the staff. Three microcomputers were subsequently added.

Mainframe software which is directly related to the Decision Support activities of the Center are EASYTRIEVE, DOCUMENT COMPOSITION FACILITY, SAS, and MANTIS. Microcomputer software consists of WORDSTAR, MULTIPLAN, dBASE II, and communications software. Additional software in the form of videotape and diskette-based training courses are available as self-instructional aids.

Physical space for the center currently consists of staff offices for individual instruction and consulting, a video room for viewing tapes and a conference room for group sessions. The entire data processing center is scheduled for remodeling work in the near future. In the remodeling plans are a dedicated user training and demonstration area, a library, and local conference facilities.

Familiarity with system security and privacy of information policies is essential for all of the Center staff. As more users are given access to the computing system to produce their own reports and querys it is the Center's responsibility to ensure that the proper authorizations have been secured by the users. Also, with the increasing frequency of microcomputer users wanting to transfer files between their machine and the host, the Center personnel must promote policy and educate users to ensure data integrity in all production systems.

Justification for the resources allocated to the Center will be evaluated over this pilot period based on the Center's ability to provide improved support to users in non-traditional areas, reductions of existing backlogs of user requests, and expanded support for microcomputing. Specific goals are as follows:

- o To reduce the number of user-training hours by coordinating and optimizing our educational offerings and techniques.
- o To reduce the backlog of user report-writer requests by encouraging, training, and supporting users to be more self-sufficient in this area.
- o To educate users in the use of appropriate software tools to augment their decision-making activities.
- o To provide a comprehensive resource for microcomputing support.

Implementing the Center

The literature available which discusses implementing this type of facility offered some sage advice - GO SLOWLY. In order to maximize the probability of success the initial service offerings were limited to those skills that the staff had already mastered. User areas where the Center could have the most impact in the shortest amount of time were targeted.

While the Center and it's activities are openly discussed, it is not being actively promoted to the user community. The experiences so far have been that word-of-mouth referral has provided a workload that barely allows time for planning and evaluation.

Below is a brief list of the major accomplishments-to-date:
Education and Consulting

- o A series of seminars are being offered throughout the year. They cover data processing services, EASYTRIEVE, and managing DP in the user area.
- o Consulting and referral communications are being restructured.
- o A video library has been established for educational materials.
- o User profiles are being developed to aid in information and news distribution.

Decision Support

- Several Users have been given on-line report writer capability on a trial basis. This was previously all batch.
- The MANTIS productivity aid has been used to generate CICS data entry, browse, and query applications for systems which needed to be developed quickly.
- A specialized download capability was developed for a microcomputer application in the accounting department.

Microcomputer Support

- Staff members are all learning to use the microcomputers so that they can provide user demonstrations.
- Assistance is being supplied to users who are planning to purchase a microcomputer.
- Diskette-based self-instructional products are available for spreadsheet, wordprocessing, and data management products.

Evaluation

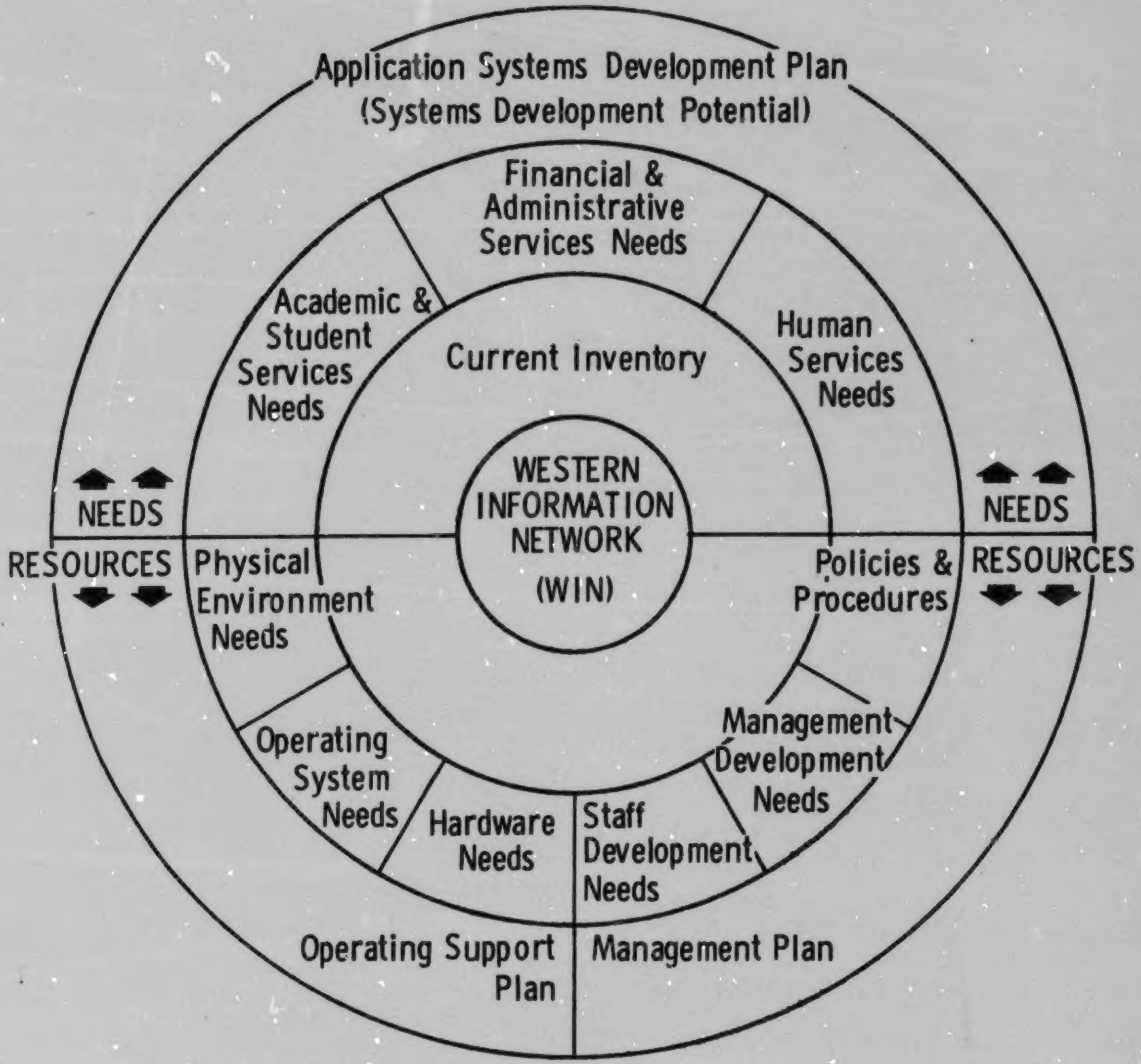
It should be no surprise that users at the University like the concept of an information/decision support center. The center is designed to provide a great deal more education, consulting, and general non-technical interaction with the computing center than in the past. It is a service oriented concept, responsive to the kinds of things that users want and need to do, and to both industry wide and university specific trends.

A formal evaluation has not been conducted. However, a number of specific cases exist within the University where the center has clearly accomplished its mission. The accomplishments outlined in the previous section are indicative of the types of activities in which the center has been and will continue to be involved.

The center's experiences to date suggest that one item be added to the list of things to be planned for when an organization is developing a center. No matter how much effort goes in to planning for workload requirements and staff resources, it would appear that workload growth for the center is relatively unpredictable. A partial solution to this problem is to return to the technique of managing user expectation, and, of course, the best time to begin this process is during the planning period. See the Planning section of this paper for the remainder of the items to be considered when planning a center.

Several problems exist. Any assumptions that were made relative to user needs remaining confined to the center's skill set or to the products endorsed by the center were incorrect. Control and response to divergent needs has been and will continue to be a problem. The idea behind having an "expert" in report writers was that this individual would provide decision support services by actually preparing a limited number of reports and spend the remainder of his time educating the users to prepare their own. The opposite has happened. A final problem, similar to that faced by a user services group in an academic computing center, is that of managing the situation where some users require a great deal of support while others are so advanced that they desire more access to the host and to data bases than the computing center is prepared to provide.

This paper concludes with a few remarks about the future. Experiences to date have confirmed that a combined information and decision support center is a viable component of the computing services at the university. The service will continue to grow; the issues of control and management of the growth will remain as the most difficult to resolve. Staffing is and will remain a problem—alternative solutions such as leveraging user groups and/or the skills of other computer center employees will have to be found.


Application Systems Development Plan
(Systems Development Potential)
Financial & Administrative Services Needs
Academic & Student Services Needs
Human Services Needs
Current Inventory
WESTERN INFORMATION NETWORK (WIN)
NEEDS
RESOURCES
NEEDS
RESOURCES
Physical Environment Needs
Policies & Procedures
Operating System Needs
Hardware Needs
Staff Development Needs
Management Development Needs
Operating Support Plan
Management Plan

CONCEPTUAL DESIGN OF THE INFORMATION/DECISION SUPPORT CENTER

Education and Consulting

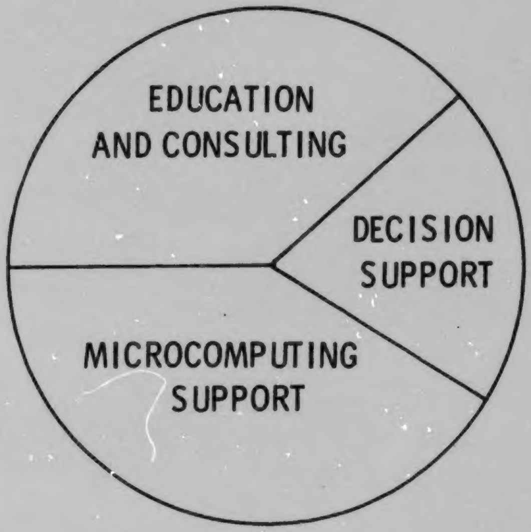
- Computer literacy education
- Consulting
- Existing applications education
- Distributed data entry

Decision Support

- ad hoc reporting
- Faster applications development
- ad hoc query

Microcomputing Support

- General support
- Micro/Mainframe link


EDUCATION AND CONSULTING
DECISION SUPPORT
MICROCOMPUTING SUPPORT

STRATEGIC CHOICES FOR DATA COMMUNICATIONS SYSTEMS

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Abstract: Colleges and universities have a responsibility and an opportunity to bring the power of information technologies to each student, staff, and faculty member in order that each may learn more rapidly and be more efficient and effective. This implies an intelligent workstation for each for computation, word processing, and record keeping as well as for such applications as simulation and computer based learning. These workstations will also occasionally have a need for access, via a data network, to a more powerful processor, or specialized software, or central data sets, or sophisticated output devices, or for communication with other workstations or with remote networks.

Issues arising in determining how to develop a data communications system to respond to these needs include: technical requirements (transmission rates, traffic capacity, network topology, switching architecture, communications protocols, and gateways to other networks); cost (and how to fund such a system); implications for coordination and (de)centralization of hardware and software selection and acquisition; deciding when to create a data network (avoiding commitment to obsolete or limiting technology); data security, information integrity, and organizational development. The various strategic choices that appear to be available are described. Replacement of a telephone system with an integrated, high performance data and voice communication system provides an occasion for establishment of campus data communications capability; the specific strategic choices inherent in this example are presented.

With information technology penetrating every aspect of campus activities, it seems appropriate for each college and university to ask how far this revolution will go, and to examine what ought to be done and how soon. Closure of the planning process has eluded most of us, however, because of the rapid development of technology and the rapid evolution of aptitudes and attitudes with regard to the computer.

At the University of Vermont, central administrative computing currently uses an IBM 4341 mainframe, accessible through 160 terminals, and a small but growing number of IBM PC workstations. Central academic computing uses a DEC 2060 mainframe and a Harris 800 minicomputer, with 275 terminals, and a small but growing number of DEC Rainbow workstations. There is, in addition, an array of laboratory minicomputers, office word processors, and individually-owned personal computers.

Access to a computer is already a necessity for all students and faculty in certain disciplines. We anticipate that within three years each student in engineering and business administration will be required to have a personal computer and that all other students, all faculty, and many staff members will require access to computing resources. For most students, faculty, and staff members, the microcomputer (MC) will be the preferred instrument; word processing, personal recordkeeping, and most computations can be accomplished locally. But individual MC workstations will also occasionally have a need for access, via a data communications network, to a more powerful processor, or specialized software, or sophisticated output devices, or central data sets, or for communication with other work stations or with remote networks. This aspect of campus computing -- the development of a **local area network (LAN)** to tie MCs together and to other computing resources -- requires a number of choices about what form the LAN will take and how to bring it into being, and has other implications for campus information technologies.

NETWORK DESIGN CONSIDERATIONS

Communications technology is changing rapidly and consideration of the LAN presents various, often controversial, technical alternatives. The examination of technical alternatives must be tempered with practical considerations such as the applications to be supported, the devices to be interconnected, the physical characteristics of the site, and the resources and long-range plans of the organization. These issues must then be translated into technical specifications as a basis for analyzing the various alternatives along five important dimensions: reliability, convenience, efficiency, cost-effectiveness, and security.

The **reliability** of a network is the degree of uninterrupted, error-free service it provides. Routing, congestion control, and flow control algorithms are major factors as is the cost of providing backup equipment and alternate transmission paths. A critical factor in the design of a network is the **convenience** with which it can be used. The physical interface must be simple and straightforward so that access to the network can be established with a minimum of effort. Also, networks are used by persons with all levels of technical aptitude; ease of use may be critical to a network's success. **Efficiency** considerations mandate that the LAN be capable of operating with low link overhead by minimizing that portion of the transmitted message which is control information for facilitating communication between computers. **Cost effectiveness** introduces issues such as installation cost, ease of maintenance, and technological lifetime. **Security** is of prime importance; since no network can be absolutely secure, security features of hardware and software are an issue from the outset.

NETWORK CLASSIFICATIONS

Local area networks are classified according to the following characteristics:

- by medium (broadband cable, baseband cable, twisted pairs, fiber optic cable);
- by topology (star, ring, bus);
- by access method;
- by switching technology (circuit, message, packet); and
- by organization and control (centralized, decentralized, distributed).

NETWORK MEDIA: The standard transmission medium for tranditional (analog) telephone services is **twisted pair copper wire**. Two twisted pairs of copper wire also form the basis of the digital PBXs which compete with coaxial cable based networks for some LAN applications. Since a rate of 64,000 bps is required for transmission of digitized voice, this bandwidth, significantly higher than that of analog voice grade lines, also becomes available for transmitting data. After adding control information to the data stream, the available data rate is approximately 56 Kbps in most cases. This data rate is still unsuitable for handling file transfer applications which require transmission speeds in the 10 Mbps range.

By incorporating packet-switching techniques into conventional circuit-switched PBX designs, copper wire is capable of supporting the high traffic applications which have been previously found only in coaxial cable based networks. For example, current PBX technology can support 8,000 data stations operating in non-blocking mode at 64 Kbps each, producing an aggregate transmission capacity of 512 Mbps.

"Non-PBX" local area networks can also use twisted pairs; one such example is IBM's planned use of a token-passing ring which operates on twisted pairs with transmission speeds on the order of 4 Mbps.

Coaxial cable networks are used for digital applications requiring high bandwidth. A **baseband** coaxial cable utilizes a single information channel shared by many users (broadcast channel) utilizing time division multiple access (TDMA) techniques. Current transmission rates are in the 10 Mbps range. A **broadband** coaxial cable utilizes multiple channels over which information is multiplexed using any combination of TDM (time division multiplexing) and FDM (frequency division multiplexing). Broadband networks take advantage of the large bandwidth, 350 million Hertz (megahertz), found in cable television (CATV) systems. Data transmission rates in the hundred thousand megabit per second range are possible. Because of the utilization of multiple high-speed channels, both analog and digital transmission can be accommodated.

Fiber optic cable has bandwidth sufficient to transmit data at 10^{14} bits per second. Current technology supports data rates in the 100 Mbps range. Fiber optic cable has a major advantage over coaxial cable and twisted pairs in that it is dielectric, i.e., it is insensitive to electromagnetic interference.

NETWORK TOPOLOGY refers to the geometric pattern formed by the physical components of the network. A network **node** is a computer whose primary function is to switch data; a **link** is the physical connection between any two nodes, more commonly called the communications **channel**. A **path** is the logical connection between any two nodes. A computer whose primary job is 'computing', rather than switching, is a **host**. Given this terminology, three widely implemented topologies will be examined: the star, the ring, and the bus.

The **bus** network consists of cable (the "bus") to which stations are attached by cable taps. Signals from the station emanate in both directions (thereby requiring a full-duplex medium) reaching every other station on the network. Decentralized control (lack of a master controller) provides for autonomous entry into the network. This, together with the fact that the nodes of a bus do no routing, account for the very high reliability of a bus network.

A **ring network**, a suitable topology for a simplex medium (transmitting in one direction only), consists of a circular chain of signal repeaters with cable links between repeaters. Stations communicate by launching messages into the ring via the repeaters which relay the messages around the ring to their destinations. Since the ring network, like the bus, utilizes a common transmission medium, the advantages are similar: full connectivity, broadcasting, decentralized control. The nodes of a ring do simple routing in that a node must decide whether to pass a message to the next station or to keep it.

The **star** network consists of a center or "hub" to which all stations are attached like the spokes of a wheel. Advantages of the star topology are: easy routing, since the hub knows the path to the other nodes; good security, because all access is controlled through a central point; and the ability to assign priority to selected nodes. The major disadvantage is that the operation of the entire network is dependent on the reliability of the central switch.

The bus and the ring are characteristic of the distributed designs of current coaxial cable based LANs. The star is characteristic of centralized local networks and long-distance networks where the objective is to provide terminal access to a central host.

NETWORK ACCESS: The most pervasive method for sharing a network medium is time division multiple access (TDMA); three widely used techniques for controlling access to a common channel on a timeshared basis are: reservation, polling, and contention schemes.

In **reservation** schemes, channel time is allocated according to a predetermined schedule. Each station has a time slot on the channel whether or not it has information to send.

In **polling** schemes, a master network controller allocates channel time on a request basis. Even when stations are idle, the controller continuously polls stations for requests for channel access. Polling schemes have the advantage of allowing the master controller to allocate channel usage equally or to give priority to a particular station. Polling is used in point-to-point networks.

In **contention** schemes, stations compete for channel access under rules that ensure orderly and equitable access. One method utilizes a **token**, a bit pattern which travels on the medium, to control access to the medium. If a node does not require access to the channel it allows the token to pass. If the node has a message to send, it takes the token, transmits the message and recreates the token at the end of the message. This technique is particularly suitable to ring topologies but can also be modified for use with the bus design. Token ring access schemes are sometimes referred to as "distributed polling" techniques since the node initiates the action in transmitting the message.

A popular contention protocol developed by Xerox Corporation for use with the bus topology is called carrier sense multiple access with collision detection (**CSMA/CD**). In this scheme, a station must listen to see if there is traffic on the channel before attempting to send a message. If traffic exists, the station must wait. When the channel is clear, two stations which have been waiting may send messages simultaneously and their messages may collide. If collision occurs, both stations must cease transmitting and try to retransmit at a later time.

Time division schemes are not the only method for sharing access to a common medium. Bus topologies can also utilize frequency division multiplexing on broadband media. Stations that communicate at different frequencies can thus use the channel simultaneously.

SWITCHING TECHNOLOGIES: Telephone systems, whether analog or digital, utilize **circuit switching** technology which requires that a complete loop (circuit) be established prior to the start of communication. This loop then remains dedicated to the communication for the duration of the session. Circuit switching is optimal for voice communications where pauses are infrequent and delays cannot be tolerated; however, it is inefficient for most data communications since the channel is not being used when nothing is being transmitted.

Message switching technology, used in message telegram systems, utilizes a collection of physical circuits interconnected by switches that examine message control fields for determining flow control or routing. In this application, circuits are no longer dedicated for exclusive use by two stations. Message switching is more efficient in its use of channel capacity and, since messages are stored during periods of heavy usage, systems need not be designed to handle peak loads. Message switching, however, can cause unacceptable delays for real-time users.

Packet switching is an adaptation of message switching in which messages are broken up into blocks called "packets". Each packet has control information associated with it so that it can be transmitted across a network irrespective of other packets belonging to the same message. The delays and storage costs inherent in message switching are thereby eliminated. Packet switching computers are programmed to allocate a packet to the circuit with the least traffic.

Packet switching has been adapted to local area networks to handle the "bursty" communications that characterize the interactions between humans and computers in a real-time interactive environment. Pure packet switching has shortcomings in high data flow environments because of overhead (routing information on each packet) and because of the delay in arrival time of packets in the same message.

Steady-flow communications are common when two computers are directly connected to transfer digitized voice, files, or video information. Circuit switching has significant advantages in these environments. Local area networks are usually packet-switched, occasionally circuit-switched, but never message-switched. As computer and communications technologies merge, hybrid forms of circuit switching and packet switching will evolve to utilize the best features of both.

ORGANIZATION AND CONTROL: **Centralized** networks are usually star topologies which require a dedicated (point-to-point) link to each device on the network because there is no switching outside the master controller. Star networks are usually found in terminal-to-host applications and smaller networks where the functions of the switch (node) and the host are resident in the same computer. In a **decentralized** network, switching also occurs in one or more independent nodes. The distinction between a centralized and a decentralized network is one of organization only; although switching is distributed to the nodes, control is exercised by the central controller. The advantage of the decentralized organization is that some form of alternative routing may be established but not every path is duplicated. A fully **distributed** network implies the existence of at least two distinct paths between every pair of nodes. In fully distributed networks, control, as well as organization, is distributed to the nodes. Each node has the ability, based on a predetermined routing algorithm, to switch between links; algorithms are usually optimized for the most efficient use of resources.

NETWORK PROTOCOLS

The Open Systems Interconnection (OSI) model from the International Standards Organization (ISO), posits a seven-layer approach to network design which facilitates the interconnection of networks that are specific to a vendor or an application. The purpose of each layer is to offer certain services to the higher layers, without the higher layers having to know the details of the way in which those services are implemented. Communications with other layers within the same host are called **interfaces**. Rules and conventions for communication with the corresponding layer in another host are called **protocols**. In reality no actual communication takes place between layers; instead information is passed down through the layers to the bottom (physical) layer for actual transmission. The set of layers and protocols comprises the **network architecture**.

The **physical layer** (layer 1) is concerned with the electrical and procedural characteristics of transmitting bits over a physical medium. The **data link layer** (layer 2) is concerned with insuring error-free data transmission. In polled networks, link level protocols, such as IBM's SDLC and ISO's HDLC, are used to establish rules for framing and error correction for synchronous transmission. In local area networks, the polling protocols of point-to-point networks are replaced by packet broadcasting techniques. Carrier sense protocols used with bus topologies include collision detection protocols, collision-free protocols and limited-contention protocols. Protocols used with ring LANs include token-passing, contention protocols, and slotted ring protocols.

The **network layer** (layer 3) determines: (1) how packets are routed through the network; (2) what happens if congestion occurs; and (3), the nature of the interface of the **subnet** (layers 1 and 2) with the host. In the case of local networks, there is no network layer since packet routing is not performed. Consideration must still be given, however, to interfacing the subnet with the host.

The **transport layer** (layer 4) is the level at which host-to-host communication is performed. Its function is to pass data correctly between the session layer and the network layer. To accomplish this, it may establish one network connection, many network connections, or multiplex high volume data over a single network connection. Functions of the transport layer include naming and addressing, connection establishment, buffering, flow control, multiplexing, and error recovery.

The **session layer** (layer 5) is the user's interface with the network. The session layer establishes the connection and manages the dialogue between two users. The session layer may add application-oriented functions to the function supplied by the transport layer such as identification of users, checkpointing, and crash recovery. The **presentation layer** (layer 6) performs functions that are requested often enough to warrant general solutions, for example, encryption, code conversion, and format conversion and file transfer protocols. User programs comprise the **application layer** (layer 7). Issues which are relevant to this layer are distributed database systems and network operating systems.

A local area network implements only the first three layers of the OSI model. The older PBX circuit-switched designs were relatively easy to implement because they utilize only the first two layers of the OSI model; however, those PBX products which provide for high-speed transmission through shared medium access also reach the third layer.

The CCITT (Comite Consultatif Internationale de Telegraphique et Telephonique, a UN subcommittee) has developed international standards for layers 1, 2, and 3 of an interlink protocol for access to public packet-switched networks. These standards are collectively referred to as X.25. The first layer, the physical layer, is defined by the X.21 standard for analog and digital transmission; the second layer utilizes the CCITT-developed full-duplex Link Access Protocol (LAP); and the third or network layer provides for packet assembly, routing, and virtual circuit management. The X.25 standard and its extension, the X.75 standard for establishing a virtual circuit across multiple networks, may provide a strategy for tying LANs together using a backbone X.25 network. There appear to be practical problems, however, and the third generation digital PBX with high-speed data switching may be a more viable alternative for the interconnection of disparate LANs. The PBX can be the single point of communications control within an organization providing for the flexibility of access from any voice/data port and the integration of multi-vendor environments. Two implementations of this concept are possible: (1) the PBX may be the backbone, providing gateways for the interconnection of diverse LANs; or (2) the PBX itself may support a LAN architecture of its own, providing high-speed access to data stations on the switch as well as providing gateways to other LANs.

DATA SECURITY AND ORGANIZATIONAL DEVELOPMENT

Returning to the specific case of a university environment, the decision to create a LAN carries both opportunities and risks. **Data Security** -- maintaining data sets, software, and intellectual property free from unauthorized alteration or copying -- is a matter of concern because of the critical nature of information residing on hosts. Files such as the student data base, the accounting and payroll files, the library catalog, student papers, research data, and faculty manuscripts will be accessible through the LAN. The potential exists for fraud, theft, academic dishonesty, accidental erasure, etc.

A second area of potential problems, involving **information integrity** -- assuring that information derived using institutional data sets is an accurate and precise representation of the phenomenon it seeks to represent -- arises because the new information technologies are intrinsically personal and individual. These technologies can be expected to favor decentralization of power and authority. Decision makers throughout the organization will have timely and easy access to what we have traditionally thought of as institutional data. Quite justifiably, they will want to use these data themselves, locally, to make better decisions or to influence the decisions of others. They will want to convert data to information and display the results of various calculations, projections, ratios, and trends. Because each will approach the conversion process with a particular set of skills, assumptions, definitions, and biases, the information produced will be of varying quality; there is considerable risk that decision makers will be misled or will mislead others.

Sensitive data sets can be protected to an acceptable degree by various measures that limit access to authorized persons. Although these techniques are reasonably well understood, most host systems in academic institutions are not adequately protected to withstand the added risk of connection to a LAN. Security safeguards should be developed in parallel with development of the LAN and be subject to continuing audit and evolution.

The threat to information integrity -- and the implied threat to soundness of management -- suggests the need for educational programs, technical support of local computing, and recognition that things can and should be done differently in a distributed environment than has been the case in an era of centralized computing. Administrators will need to learn non-procedural languages to facilitate the conversion of data to information.

The new information technologies and the creation of a LAN imply that all students, staff, and faculty should acquire certain computing skills. Overall, it will **not** be necessary or desirable that each person learn a programming language. We run the risk of steering more students toward high technology careers than can possibly be accommodated. However, the information technologies, including such things as videodisc, should be strange or forbidding to no educated person.

Faculty who wish to use information technologies effectively in their instruction will need an entirely different set of skills which encompass the nature of learning, the use of computers in the learning process, and the various ways in which computer-based learning differs from traditional classroom learning.

Every student, faculty member, and staff person will need a new perspective on their tasks. The sociological implications of the information technologies in our organizations are likely to be greater than we can hope to foresee. Most institutions have begun to develop the educational and intervention programs needed, but the widespread use of the MCs and their interconnection via a LAN will require attention to organizational development at a level that most of us have not begun to contemplate, plan, or implement.

IMPLEMENTATION CHOICES

It is tempting to delay the implementation of these changes because the technology will become faster, or cheaper, or to wait for others to make the mistakes. Many institutions will wait too long; the technology will always be improving and getting cheaper. The rate at which young people are adopting the MC makes it imperative that we bring information technologies promptly to center stage. The integration of the MC implies the establishment of a LAN and the attendant adjustments in the way we conduct our activities.

The technologies are expensive and complicated, seemingly beyond the means of most colleges and universities. The costs include the network medium (wiring the campus), the switching technology, and software and maintenance -- as well as the increased demand for central computing services, applications systems (e.g., library automation), workstations for faculty, staff, and administrators, and educational and organizational development programs.

There is also a significant risk that a particular set of technological strategies will prove to be limiting before the investment has run its course. Under these circumstances -- high investment required in a time of financial constraint for uncertain benefit -- the wisest choices are those that hold costs down, use multiple funding sources, and limit technological risk.

Given these conditions, the University of Vermont has adopted the following strategies and policies:

(1) Acquisition of MCs or workstations is funded locally, i.e., there is no central funding. Most departments have found the means through regular budgets or from grants and contracts; many faculty have bought MCs with personal funds.

(2) Central technical support, repair service, and discount purchase plans are provided for two types of MC. These workstations currently have preferential access to central computing services.

(3) Portions of centralized development resources are being redistributed to provide consulting support and training for persons in user offices in the use of non-procedural applications development tools.

(4) All hardware and software acquisition is subject to central approval. Units are advised concerning the advantages and disadvantages of various options in terms of quality of the product, central support, ease of integration with other systems, maintenance, and service.

(5) Issues of data security and information integrity are being addressed through control of access to sensitive data, training programs, limits on the form in which institutional data is released, and through use of a chargeback system to decrease frivolous use.

(6) In certain disciplines, students will be expected to buy their own MC when they enter. We will develop insurance, maintenance plans, and financial aid arrangements before this requirement is implemented.

(7) A library system is being developed that provides catalog access through terminals or workstations anywhere on campus (including dormitory rooms) through the LAN. The total cost of the library system, about $2 million over four years, will be sought through gifts and grants.

(8) We have begun planning for upgrading our central academic and administrative computer mainframes to meet the increased demand.

We expect to handle all of the foregoing within available resources. That leaves the LAN, a multimillion dollar investment, that we could not handle if it were not for a set of fortuitious circumstances.

INTEGRATED VOICE AND DATA COMMUNICATIONS

The fortuitious circumstances are the announcement of third-generation integrated voice and data switches coincident with the breakup of AT&T. The latter promises to result in escalating telephone charges for all of our institutions and instant obsolescence for those served by Centrex exchanges. The former provides an opportunity to replace a telephone network owned by the Bell system with a LAN which will serve most data communications needs and provide better telephone service.

A third generation digital PBX has three basic characteristics: (1) distributed architecture, employing coaxial cable or fiberoptics to connect the central switch with the nodes in order to support high-volume communications; (2) integrated voice and data transmission; and (3) a non-blocking configuration, permitting all ports to be connected on a fully-available basis.

In considering this approach to establishment of a LAN, we set the following major technical requirements:

(1) Simultaneous voice and data transmission must be supported without reduction of port capacity or reduction in overall performance.

(2) The data switch must be capable of replacing the Gandalf PACX data switching system used in our Academic Computing Center and the network of leased lines and coaxial cable used to support remote communications with our Office of Administrative Computing.

(3) The data switch should provide for integration of the data communications environments of the campus. This includes accommodation of the communications protocols in use and protocol conversion to facilitate access to any host from any campus terminal or workstation.

(4) The data switch must be capable of supporting reasonable expectations of growth, in terms of number of connections (terminals, workstations) and increased traffic volumes associated with the eventual accommodation of a MC for each student and faculty member.

(5) Mandatory support of transmission speeds of 19.2 Kbps asynchronous and 56 Kbps synchronous.

(6) Mandatory support of transmission speeds up to 10 Mbps for host-to-host communications and for "downloading" of data files to workstations -- without significant impact on other simultaneous transmissions.

(7) The data switch must permit access to local as well as public packet-switched networks, specifically including support of the X.25 standard.

(8) The system must be based on a distributed architecture to permit the respective hosts to exercise network control over data traffic for purposes of network management, security, and trouble shooting.

(9) The switch manufacturer should be committed to providing a full range of system enhancements over time, as well as appropriate maintenance and support of the current system for at least ten years.

We believe that these specifications limit our technological risk to an acceptable level but, as an extra precaution, our RFP calls for an extra pair of coaxial or fiber-optic cables to be installed between all key campus buildings at the time of wiring the campus for the PBX system. Presumably that would permit some high-speed communications to take place on an a broadband or fiber-optic network, independent of the PBX network, if needed at some later time.

There appear to be two or three third generation switches that can meet most of these requirements. The good news is cost. Although we have not completed the bidding process, it appears that we can establish the LAN and have a better telephone system for about what it would have cost us to continue the obsolete Centrex service. The project calls for data connections in 1700 offices (3500 telephones) and data ports/phones in 2000 residence hall rooms. The initial capital cost is expected to be in the $8 million to $10 million range, including physical plant and contingency allowance. Bonding over a ten-year period, network access, startup costs, administration, power, and maintenance must be added to the initial capital cost; the grand total, over the ten-year period, amounts to about what we would expect to pay for our current inadequate telephone service over that period. We will own the system at the end of ten years and, while it is likely that we will want to replace the switching system at that time, the wiring and physical plant portion should have an extended life.

SUMMARY: We believe that universities should not postpone the establishment of a LAN to serve existing data communications needs and to interconnect the growing number of MCs. Although the costs, risks (of technological obsolescence, and to data security and information integrity), and organizational development requirements are not insignificant, we believe that the combination of a third-generation, high-performance, integrated voice and data communications system with ancillary broadband or fiber-optic cabling will provide the capability needed for a ten-year period and can be funded for what it would cost to maintain current telephone service alone.

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IMPACT OF TECHNOLOGY ON THE UNIVERSITY OF MIAMI

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ABSTRACT

While it is difficult in any rapidly changing environment to predict five years into the future, it is possible to detect trends and extrapolate their effect on the organization. Much of the technology that will be commercially available in the future already exists in experimental form today. With proper research and intelligence, it is possible to make a reasonable estimate of the trends within the planning horizon. As a part of a long range information systems planning effort, an assessment of the impact of technology on the organization was developed. This paper shows the trends identified and suggests the anticipated impact on the University of Miami.

INTRODUCTION

The University of Miami is a private, independent, nonsectarian university which was chartered in 1925 as a nonprofit institution of learning, whose policies are established by a self-perpetuating Board of Trustees. The University serves approximately 20,000 credit and non-credit students each year. The Information Systems & Planning organization supplies the information, services and facilities needed by the University to support its institutional objectives, along with providing staff support to the President as the chief planning unit. The following are the Information Systems & Planning organization's major objectives:

- Plan and coordinate an environment to store and safeguard the computerized official records of the University
- Plan, approve, and/or develop the automated applications necessary to collect, maintain, and display computerized official University records
- Provide planning, consulting, advising, and facilitating services to the University community for the acquisition of computer hardware, software, and the development of procedures
- Plan, coordinate, and approve the hardware environment to support university-wide computing needs
- Provide the production environment necessary to support the processing of shared official records in the university-wide information architecture

In October, 1983 the University of Miami published a plan to address its information systems requirements for the ensuing 5-7 years. The Long Range Information Systems Plan that resulted took four calendar months and approximately four effort-years to complete. This paper summarizes the Plan's findings concerning technological issues.

TECHNOLOGICAL TRENDS IN COMPONENTS

In order to assess the overall impact of developments in technology, it is necessary to examine the trends within the major components that comprise any modern information system. These components are: hardware, office automation, systems and data base software, and communications.

HARDWARE TECHNOLOGY

The most significant trend in computer hardware technology is the continued reduction in physical dimensions and cost. The computer industry's astounding progress has made it both physically and economically desireable to place computer hardware as close as possible to the human/machine interface point. We now see computers in watches, televisions, electronic organs, automobiles, microwave ovens and a diverse spectrum of other consumer goods. More importantly for information processing, the cost/size reductions have made the personal workstation a reality.

Large shared mainframe computers are becoming specialized in the handling of massive data sharing requirements, and soon will leave the preponderance of data manipulation and interactive tasks in the realm of the minicomputer and microcomputer. Mainframes are, of course, also benefitting from continued improvements in integrated circuit density as the processor becomes less and less conspicuous in computer rooms of today. Higher densities will also continue to expand the capacity of data storage devices yielding improved tape, disk, and optical storage capacities.

Minicomputers are more capable than ever before with a steady migration towards larger word sizes and increased speed. The same is true of microcomputers and personal computers. The potential market for these devices is offering financial incentives for ingenuity which is spurring an exponential growth of technology. The availability of significant storage capacity, such as fixed disk on the larger personal computers, is showing the way to new horizons in information processing. The work being done to refine the human/machine interface with color graphics, touch sensitive screens, voice synthesis and voice recognition will help small computers to be accepted by even the most reluctant users. To further stimulate the race towards personalization in information processing, all of these qualities will be available in portable models which adds another facet to their popularity.

OFFICE AUTOMATION

The purpose of office automation is to improve the performance of the business operations of an organization. As it has turned out, office automation has been a fascinating experiment in the computerization of administrative record keeping and document production tasks. However, office automation is now being accepted as a subset of information processing, and the delineations between the two are becoming less and less clear. As originally introduced, stand alone word processing units were viewed as a boon to office productivity, even though they did not necessarily improve overall business performance. It is now recognized that effective office automation requires the sharing of resources among both local and institutional users for the business mission to be pursued more effectively. The desireability of access to larger data bases for basic standard information is forcing office automation and information processing together in order to reduce the cost of information handling.

Stand alone word processing has become a modern controversy. The most significant contrasts between personal computing and word processing have been the dedicated software used for word processing and the customized keyboard arrangement. Word processing keyboards and software were designed in tandem towards optimized document production activities. A significant movement towards the use of more generalized machinery, such as microcomputers, for word processing is underway through the availability of specialized document-oriented keyboards and software. As a unique discipline and information architecture component, office automation will probably be engulfed by personal and office computerization in general.

SYSTEMS & DATA BASE SOFTWARE

The most exciting developments in this component are the continued improvements being offered in flexible mainframe data base software and application development aids. Major software forces have released powerful software which combines the high volume efficiency of a structured network with the capability of relational views within the data base. Cullinet's IDMS/R and IBM's recently announced DB2 are just two examples. High level languages are yielding fantastic returns in productivity with online transaction, query, and report writer languages. The power of data base is also available on minicomputer and microcomputer systems which is making data manipulation at this level extremely cost effective when contrasted with mainframe costs.

The inability to segment the institutional data base is currently one of the major obstacles to the totally effective use of small computer systems. There is still a need to physically locate institutionally shared data in the central environment, even though application programs may effectively reside at decentralized sites. There are current developments underway which show promise in allowing the creation of a single large logical data base which can been physically decentralized according to tuning parameters. The importance of this development will be to allow the physical and logical networking of smaller systems into a single large shared data environment. Along these lines, several vendors are offering mainframe integration software for minicomputers and microcomputers which will allow simplified access for upload and download data movement tasks.

COMMUNICATIONS

With the popularity of small systems, and recognizing the need for an institutional shared data base, effective communications takes on more importance than ever before. The recent movement towards combined voice and data transmission is the logical choice for today's information architect. This technology allows the basic communication system to operate in digital mode. Onto this system, voice is digitized at the transmitting instrument via a coder/decoder (CODEC) and decoded by the receiving device. The capacity for providing computer terminal access to the network at each telephone installation without a modem is opening new horizons in information systems design. Each computer which is connected to the network becomes a potential host, which can allow more effective use of computer resources for institutions with multiple computer sites.

Special interest networks, such as EDUNET and Dow Jones, allow access by subscribers with similar or specialized interests. Other specialized networks are useful for meeting the needs of those users who require unusual or extremely powerful computing not available locally. With the availability of electronic input to typesetting equipment, the transmission of large quantities of data for upload, download, and special printing, the increased transmission of video signals, and the proliferation of computing devices operating at higher speeds is placing an increasing load on communications facilities. Planning today should allow for the tremendous upsurge in traffic anticipated within the next few years.

ARCHITECTURES - PUTTING TOGETHER THE COMPONENTS

Having examined the component technology, it is difficult to bring a complete picture into focus. The tendency is to use one of the components as a basis for information systems design. For example, it may be convenient to consider hardware as the basis for an overall institutional design, but this can be misleading. When considering mainframe hardware, it is difficult to contemplate multiple processor configurations which effectively form a single unit. The University of Miami has recognized the need to share information among operating units as the basis for design. Based upon an extrapolation of the trends in each of the major components: hardware, office automation, systems and data base software, and telecommunications, the University of Miami formulated a global information processing architecture. This overall institutional architecture, as depicted in the Appendix, represents a three tiered approach which is defined in terms of the level of sharing required: institutional, local, and personal.

INSTITUTIONAL LEVEL

The cost-effective need to share information, services, and facilities is the rationale for investment in a central facility. The central facility forms the highest level of sharing for the University of Miami. Allowing connection of minicomputers, word processors, personal computers, and terminals, the central facility will form a bridge of commonality. The University of Miami's institutional level facility will remain based upon medium-sized mainframe technology for the forseeable future. Although referred to as "central", the facility may include more than one mainframe, located appropriately. The high volume of information resident in the central facility will be concentrated in a production oriented data base structure. Control over the integrity of the data base will be the responsibility of the Information Systems organization. In contrast, the responsibility for the contents of the data base will be diffused among defined organizational units. The main data base, voluminous and highly shared, will need to be structured for efficiency. Centrally developed applications will facilitate routine data base access, inquiry, and update. Other uses of the information will be fostered through the development of software "delivery systems" which will transfer subsets of information outside the central data base environment for further analysis at the user's site.

The trend in application software has been towards streamlining the system development process through application generators and report generators (referred to as fourth generation languages). These aids are generally integrated with the data base management system. The availability of such development aids encourages the use of innovative design techniques, such as prototyping. A prototype is a model of an application system which can assist the user in clarifying requirements before a large investment is made in the finished product. Using these techniques, user involvement is high, tangible results are rapid, and overall programming and documentation efforts are reduced.

All of the trends in technology and the information requirements of the University of Miami emphasize the need for an institutional level shared facility. By allowing for university-wide sharing of information and resources, the University can anticipate much greater synchronization of its operating administrative units.

SHARED LOCAL LEVEL

Typically based on minicomputer and microcomputer hardware, shared local systems are characterized by shared data, applications, and resources, usually at the operating unit or department level. Quite often storage is shared, and the processing units may also be shared. Since shared local systems use various communications protocols within their local networks, communication with other local or central systems frequently requires protocol conversion. Many of the available configurations offer protocol conversion to enable local terminals to easily act as members of the institutional level facility. Shared local installations are technically sophisticated and require skilled local operational management. Data are shared at a local level only, using file or data base capabilities. The data structures need not be as highly performance oriented as those of the institutional facility, and can therefore offer greater flexibility. The sponsoring operating unit or department must have responsibility for data integrity, control, backup, recovery, disaster planning, and data validity.

The shared local system is characterized by the use of application software packages. The applications, and therefore the shared systems, cannot be justified when a majority of the information is of material value to others within the University's administration. A useful rule of thumb for judging the applicability of an application for this architecture is the "80/20 Rule". This states that if 80% of an application's data is of local interest only, and conversely, that no more than 20% is of general interest to the University's administration, the application is a candidate for the shared local architecture. Applications which require basic identification data, such as name and address, to be downloaded, and generate financial transactions to be uploaded, generally fall within this definition.

PERSONAL LEVEL

With the advent and popularity of affordable desktop systems, the personal computer has become an important component of the University of Miami's information architecture planning. Personal systems are based on microcomputer technology. Capable of emulating various terminal protocols, when contrasted with unintelligent terminals they can offer significant expansion of capabilities for small incremental cost. For example, each can operate as a stand-alone system, function as a component of a shared local system, or connect via communications to other networks, including the shared institutional facility. This flexibility will lead towards overwhelming popularity.

The movement towards personal computer systems at the University of Miami will be assisted through the availability of training and consulting services. However, the responsibilities of the owner include data control, validity, integrity, backup, recovery, privacy, and security. When connected to a network, including the institutional level facility, the responsibilities become similar to those of other terminals in the network.

Because of the relatively low cost, excess computer capacity can often be justifiable at the personal level. Data structures tend to exploit this fact by encouraging extreme flexibility. This flexibility highlights the personal systems as an excellent means for data analysis. In contrast to the central data base environment, practical software packages proliferate for the personal computer market. These packages are generally friendly and well documented.

At this point in time, it appears that personal computer systems will be most useful in receiving subsets of data from the main data base and further analyzing the information to produce graphics and special reports. The data subsets may also be used in various modeling systems. Additionally, personal systems will aid in maintaining many forms of unshared data which would not be of interest to others. At the University of Miami, the personal level system will be included as an integral component in the university-wide system application design process.

SUMMARY

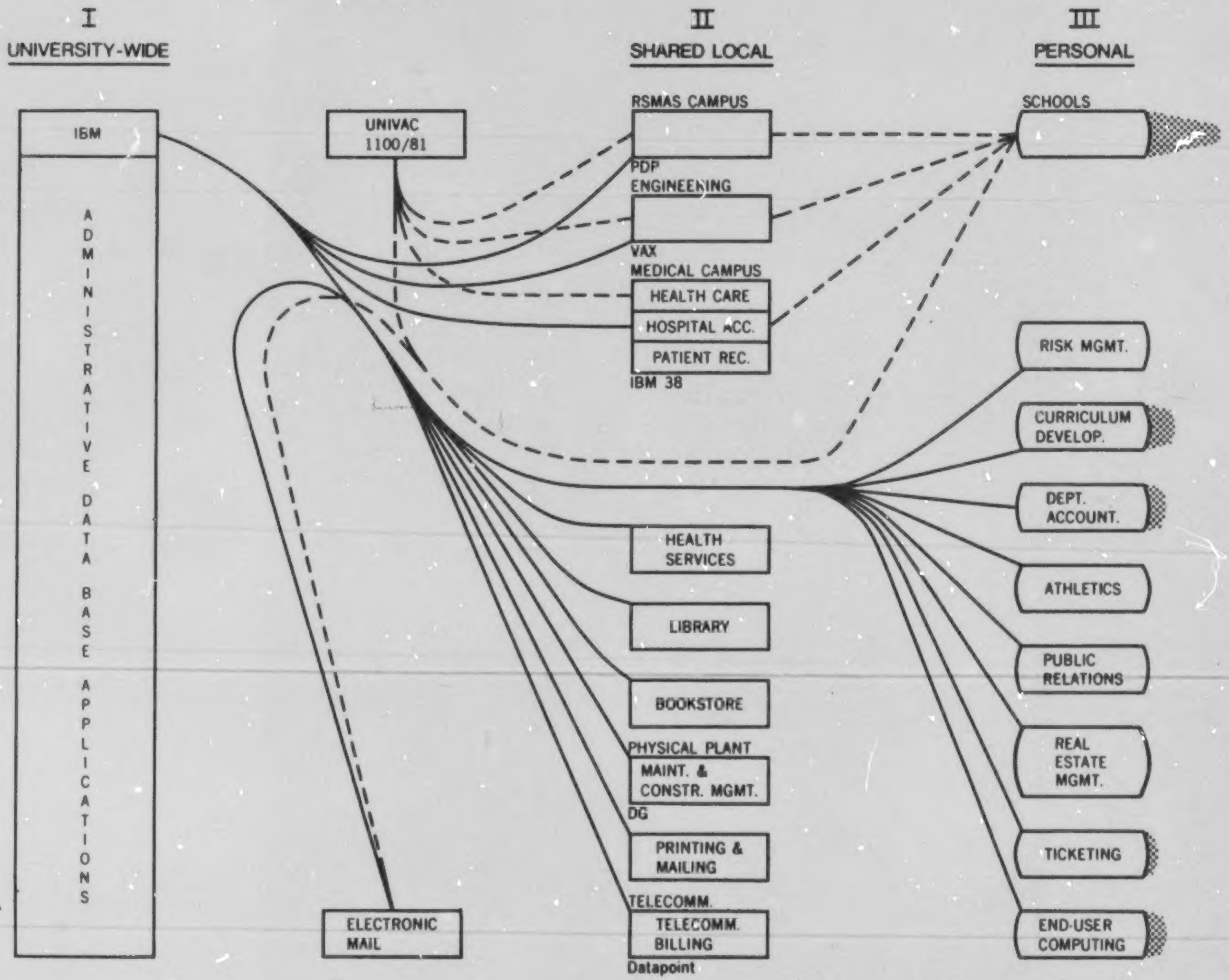
Examining the trends in the component technologies provides the basis for structuring an omnibus architecture to meet the demands of the next decade of information processing. The trends in computer hardware point towards continued decreasing size and cost, placing computer power at the closest point to human interaction, with great strides underway to make this interface point less intimidating to the uninitiated. The explosion of personal computing is threatening to overshadow office automation as a unique discipline.

Movements towards greater flexibility in mainframe data bases, and the emergence of strong high level development tools appears to be stimulating a resurgence of custom-developed software in many institutions of higher learning. This, coupled with personal computing calls for extreme conservatism in today's communications planning.

Putting the pieces together, the institutional data view is an effective way to organize the components. The University of

Miami has recognized three interdependent arenas for automation. The Institutional Level, based on mainframe technology, allows for the highest level of data sharing in a centralized data base network. The Local Level provides for contained data sharing within departments or operating units, while the Personal Level allows dedicated manipulation of shared data and the proper environment for unshared data.

PROCESSING ARCHITECTURE SCHEMATIC


I
UNIVERSITY-WIDE
II
SHARED LOCAL
III
PERSONAL
IBM
ADMINISTRATIVE DATA BASE APPLICATIONS
UNIVAC 1100/81
RSMAS CAMPUS
PDP
ENGINEERING
VAX
MEDICAL CAMPUS
HEALTH CARE
HOSPITAL ACC.
PATIENT REC.
IBM 38
SCHOOLS
RISK MGMT.
CURRICULUM DEVELOP.
DEPT. ACCOUNT.
ATHLETICS
PUBLIC RELATIONS
REAL ESTATE MGMT.
TICKETING
END-USER COMPUTING
HEALTH SERVICES
LIBRARY
BOOKSTORE
PHYSICAL PLANT
MAINT. & CONSTR. MGMT.
DG
PRINTING & MAILING
TELECOMM.
TELECOMM. BILLING
Datapoint
ELECTRONIC MAIL

Management Tools for the 80's

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ABSTRACT

Using the two basic functions of management, namely organization and control, the authors first describe a naming convention that is used to identify those parts of a system common to the system and identifiable throughout the data center. In support of controls for computer center resources, the authors discuss applications and software packages available. The objectives and benefits of a good job accounting system, disk and tape data management, hardware reliability, error recovery and security packages are presented.

MANAGEMENT TOOLS FOR THE 80'S

The basic functions that a manager must perform can be described as 1) organizing, 2) planning, 3) communicating and 4) controlling. This paper will deal with two of these functions that are necessary for managing a computer center, namely organizing and controlling.

The first topic deals with how we identify the parts or items that make up our system. Any naming convention should tie all the items together within a system. For example, we may want to identify files, reports, programs, forms, etc. that we encounter in our day-to-day activities within the center. The nomenclature that we found most useful not only tied the "items" of a system together, but also satisfied the following definitions which describe most operational systems.

1. A system is implemented in time-dependent jobs called job runs. Time dependent simply means certain jobs must be run and completed before other jobs can run. For example, we normally want our files updated before we run our reports.

2. A job consists of a series of steps to be performed.

3. A step is a task that is automated (computerized) or it may be a manual task that has to be performed.

4. A computer program is an automated step or task.

At this point we would like to emphasize that this definition will apply for either time-sharing or batch-type applications. The differences will be reflected in the job-run flowcharts.

Using the above definitions we would like to define a job reference number whose sole purpose is to identify all the parts of items within a system. Please note that this job reference number will also serve as the identifier of any internal chargeback reporting.

The format of the job reference number is eight positions: the first 3 positions identifies the system and the fourth position identifies the job, step, program, report, etc. The last four positions are sequentially assigned as required. The eight positions are as follows:

AANBYYYY where the first three positions identifies the system;

Example: PR1 - The first payroll system
PR2 - The revised payroll system

AANBYYYY the fourth position is a letter that identifies the item or part of the system

Identifier Codes: B

D - Disk file
F - Form number
J - Job number
M - Memo number
P - Program number
R - Report number
S - System or step
T - Tape file
U - Utility program
X - Subprogram
Q - Screen format

Examples:
PR1S0000 - Payroll system
PR1P0010 - Payroll program #10
PR1R0001 - First report number 1 in the payroll system

Design Standards

Continuing with the application of standards to system design it is important that the items listed below be completed in the design documentation before the programming begins. These items will reduce interface problems that cause most system failures. The following items are standard for system design:

1. Job run flowcharts
2. File layouts
3. Data logs
4. File logs that cross reference files with programs
5. Form log and report log
6. Report layouts with report numbers
7. Screen format with screen numbers
8. Program specifications for each program
9. Program logic flowcharts

The above items need the standard naming convention of the job reference number to identify reports, files, programs, screen formats, forms, and jobs by a unique number. The file and form logs are a cross index between files and forms to their corresponding program number.

Programming Standards

As we continue into the development of programs, it would be beneficial if each programmer coded using the same standards - basically with the same tools. Would you like to take your Chevrolet into the garage and have it fixed with a machine that was equipped to service a Mazda? In applying standards to programming we first will standardize the language and second discuss the program structures.

The verbs ALTER, VARYING, UNTIL, Nested IF's, compound verbs such as AND, OR, etc., will be prohibited. The KISS method will be applied to coding with one statement per card. Paragraph names will be sequenced with A10 before A20, etc. The program will be modular with perform statements in the main line and all paragraphs physically located at the bottom of the program. No paragraph may be accessed by falling through the paragraph to be performed. If you have coding standards, productivity will be high because you will not be spending all of your time trying to identify items not clearly defined. Your programmers will also have a common method to apply for program coding and will have the ability to read each other's programs.

What Kind of Documentation and How Much

In this section the documentation will be tied together within the various sections of the computer center. When a set of standards as described above are used, the systems documentation can be broken down to satisfy what is needed by the major sections within the computer center.

Systems documentation encompasses the three main areas of support, the Systems and Programming Section, Operational Section, and the User's Department. The Operational Section consists of three areas, Data Entry, Scheduling or Control and Computer Operations.

As illustrated on the following pages, each section's documentation is based on the needs of that section. Some of the documentation is duplicated to satisfy that need. For example a report log is required in the Systems and Programming documentation, in the Control Section of the computer center for distribution of reports, and finally in the user documentation to let the external user know what reports are available and when they will be run.

The following documentation is a suggested breakdown by section and can be adjusted to meet the needs of your organization.

System Documentation

A. Systems and Programming Documentation

1. System Documentation
    a. System flowchart
    b. Job run flowcharts
    c. Input forms and formats
    d. Output forms and formats
    e. Output report layouts
    f. Master file layouts and data logs
    g. Screen formats
    h. Report log
    i. File log
    j. Program log

2. Programming Documentation
    a. Program flowcharts
    b. Program specifications
    c. Program listings
    d. Sample inputs and outputs
    e. Work file layouts

B. Operational Documentation

1. Library
    a. Assigned space for disk
    b. Rotational procedures for tape

2. Control
    a. Run request/scheduling procedures
    b. Deck setup or JCL listing by program by job
    c. Report logs and distribution
    d. Logging and balancing procedures
    e. Job run flowcharts

3. Keypunch
    a. Sample form and card layouts
    b. Keypunching and verifying instructions

4. Operators
    a. Job run flowcharts
    b. Operating instructions for each step
    c. Error and recovery procedures for each step
    d. JCL listing by job

C. User's Documentation
  1. Job name and number
  2. Description of each job
  3. Run request procedures
  4. Schedule run log of each report
  5. Report log
  6. Description of each report with samples

Benefits of Standards in System Design

Not only does the job reference number identify the items within a system, it goes hand in hand with job accounting so that your job accounting reports by job run or program steps are now formalized and the user community has more confidence in the computer center's reporting. No longer will you see such programs or steps named "HARRY'S - WONDER" or "MARGE'S - BEST."

A second benefit derived from utilizing this standard is that manual procedures within your center can also be documented in the same manner. Each manual set of steps can be related to a unique job number. Similar forms utilized for standard practices can be assigned a system prefix. For example, our center utilizes several types of standard forms in the documentation of each system. We assign to forms such as Program Logs, Report Logs, Operation Trouble Report Logs a general form number that has a system prefix PP1 (Practices and Procedures).

The benefits from standard naming conventions for all systems within a computer center is immeasurable. We now have a method of tracking every form, program, tape file, etc, that we use.

By associating the standard naming convention into our job accounting system, we have a better management tool for the control of disk and tape files as well as assistance for system project control. The development cost of each system is captured and this cost is then separated from production costs. We can also utilize these standards in the tape library and disk library systems as we relate the usage and space reporting back to the system that requires these files.

Job Accounting

Job accounting is a tool that can be used to relate project costs, user demand on resources, and hardware usage. Our approach to job accounting will be to describe the files to you and then discuss the reporting requirements. First let me define job accounting as a system or procedure that will capture all labor and machine costs within the computer center.

Three master files are required to capture the data, a work order master file, a time and activity file to collect both labor and machine time, and a table master file with "type of work" codes versus cost and price data. Cost table entries by type of work are required to recover the cost of running your center. Price tables are also used to price your services above your cost for an outside user. The work order file captures the user identification such as department, account number and the percent to charge each account up to five accounts. The work order number is the internal charge number to use on time sheets and the computer job card. The work order is at least a five-digit number with the first digit being the year it is issued. The second digit references the cost center within the computer center. For example, a number 34005 is the 5th work order issued in 1983 to request Administrative development. The "4" references all work performed by the Administrative section, a "3" might represent academic systems and programming, and a "9" could be administrative production, etc.

The typical job accounting system will sort the time and activity file by work order number and compare the sorted work order master against the work order master to produce charges against the project. A subfield called type of work must be recorded on each time sheet entry and computer system master file to produce charges by the correct type of work rate for programming versus system. The system master file (SMF) will record the job card of a computer run and automatically place a type of work code for example '40' to signify a computer run.

The time and activity file will have both the machine SMF records and labor recorded. Machine utilization reports for tape I/O, disk I/O, cards read, lines printed, connect time, etc. can be produced for management over any given time period. The job accounting system is the manager's tool to provide him with hardware utilization, user charges and project costs by work order number.

Operations

Up to this point we have discussed development standards and cost reporting to control our resources. Now we will discuss the control function for the production areas. The functions for which the Manager of Operations is responsible, are: data management, production, resource management and security. The presence or lack of adequate controls in any of these areas can determine the efficiency, availability, accuracy, and the ability to recover computer center resources. Additionally some of the newer and most useful of the turnkey software tools to help with the management of computer resources are in the area of data management.

Data Management

The area of data management currently consists of attempting to control data stored on magnetic tape or data stored on some type of direct access storage device (DASD), usually disk. This requires an investment of time and/or funds in a tape management system and/or DASD management system. Although both of these systems deal with data storage management, the reason for installing each system differs. We will, therefore, consider the control requirements for each of these systems separately.

First we will discuss the tape management system. When we consider either developing or buying a tape management system, there are several major questions to be asked:

- Does the system have the capability to manage all of the tape handling aspects such as providing reports defined by the operational staff?
- Is the system flexible enough to handle future changes in your environment?
- Does the system provide as complete data protection as possible?
- Will the system prevent most critical mistakes by the operators? Is there full backup to the system and a full audit capability? Is there assurance that the system is up whenever needed and that the system data is correct?
- How easy is the system to install, maintain, and operate?

With the installation of any good computer system, we hope to turn these objectives into benefits. Depending upon the starting environment of the computer operation, different benefits may be realized in different situations, these major items are:

- Improved reliability in tracking tapes
- Better tape data set security
- Quicker availability of tapes
- Increased flexibility in types of retention
- Improved control over tape maintenance
- Better management of disaster recovery

It is important that your objectives be defined closely enough so that you get those benefits that will do you the most good, not those that a vendor has available to you.

Disk management, our second data management topic, is becoming vitally important as new hardware offers more tradeoffs in cost effectiveness, storage density, access time, etc. As the demand increases for more information processing and especially for more online data access, and as more budgetary contraints are placed on computer centers, the problems of insufficient free disk space, uncontrolled allocation of data sets, and lack of information about the current DASD environment can often be the determining factor in the acceptability of a new or expanded system.

The following benefits should be provided by a good DASD management system:

- Control of the allocation and removal of data sets
- Increased security, integrity, and availability of data sets

- Reduced job run problems
- Reduces abnormal end of job
- Better disk/channel performance
- Decreased time spent on fragmentation
- Reduced need for more DASD
- Increased knowledge of DASD status

There are other alternatives to data management for operations managers. Usually these alternatives will be in the form of adding more people to monitor the data sets, buying more tapes and more disk drives, writing additional report programs, or appointing a data manager and staff. All of these points are only partial solutions and must be measured against the cost of developing or purchasing data management systems.

A second major area of concern for which the operations manager is responsible is production control. Production control, for our purposes, will consist of the following items:

- Maintenance of operations documentation
- JCL management
- Software change control
- Input data control
- Job set-up and scheduling
- Job status tracking
- Job ABEND restarts control
- Output control
- Distribution of output

A data center's problems are usually caused by programming errors or hardware problems only 25% of the time. The other 75% stem from problems related to manual efforts within the production area. One way to decrease the number of problems is to concentrate on parts of the production effort that lend themselves to automation.

Looking first at a system to handle the scheduling task, what are some of the major functions we could expect to automate? A good scheduling system should provide the following:

- Organization and definition of incoming data
- Forecasting of the future workload
- Automated initiation and control of processing tasks
- Comprehensive reporting and performance analysis

What are some of the benefits we should expect to receive from a scheduling system?

- Decreased JCL errors, more staff knowledge, and less reliance on key personnel because of standardized workload definitions

- Recognition of bottlenecks and workload requirements prior to the actual need

- Better workload sequencing and balancing, better facilites scheduling, and the elimination of reruns due to out-of-sequence processing

- A better planning process because of the availability of accurate performance histories

A second area of production control that is a prime candidate for automation is in the area of job reruns. Rerun management, because it is such an important part of production control, should provide for the monitoring, reporting, and control of reruns. The monitoring and reporting of reruns should allow the operations manager to determine the impact of reruns on the production schedule, the causes for the reruns, the amount of wasted resources, and identify recurring causes. The rerun control should be automatic so that operators are free from very difficult and error prone manual rerun procedures. Since the use of step restarts is desirable instead of full reruns, any system considered should handle step restarts automatically.

The benefits that we should expect from an automated rerun system are:

- Reduced costs for hardware, personnel, and supplies
- Fewer missed deadlines
- Increased user satisfaction

One additional software tool worthy of a short discussion is that of a hardware reliability measurement system. It can be called an antifailure system, but in itself it cannot prevent failures, only provide the information necessary to educate, identify, and apply pressure. A good system should provide:

- A review of the reliability of individual devices to identify weak links

- Feedback on the adequacy of the maintenance

- Comparative data between vendors by which to measure the relative reliability of equipment

- Data to aid in the selection of new equipment

- Increased vendor accountability

The computer operation that will be the most reliable is the one in which the management is fully aware of the reliability of the system and the individual devices. The single necessary ingredient needed to make a hardware reliability system work is a sound relationship between a knowledgeable user and a good vendor.

SECURITY

Although as managers we have responsibility for both physical security and access to our installation, today we will be discussing the ability to stop unauthorized persons from gaining access to your data files.

The basic objectives of computer security is to provide corrective measures to reduce all threats from every source thus resulting in a certain level of risk. Remember the threats can be both malicious and non-malicious. Your job is to stop all threats that are made to access your center and your data by unauthorized persons. Log on codes and passwords are easily broken with the use of dial-up ports and personal computers.

A good security package intercepts each log on by the user and verifies that the user is authorized to access computer and then to only certain data sets. Only those users with predefined attributes may have access and if they do obtain access they may still be restricted to a READ only of their file. The center must plan far in advance to install such a package. Most security packages will have several modes of operations.

- The dormant or quiet mode provides warning messages.
- The fail mode aborts unauthorized users who attempt to use defined files but allows access to undefined files.
- The abort mode will stop all users that are not defined.

Logging of all activity and violations must be available for all modes. Usually there is a migration from dormant to fail to abort modes as the package is installed for each system.

There are many packages today - IBM RAC-F, TOP SECRET, SECURE, ACF-2, GUARDIAN, SECURE, and COPS. Most of these are for CICS users in an IBM environment, but you may select another by doing some researching with your vendor.

In conclusion, we have discussed the organization and control of a data center. The awareness of the tools that are available is a start. Naturally the alternatives to these tools must be weighed carefully against the cost benefits.

TRACK III
Technology And Techniques

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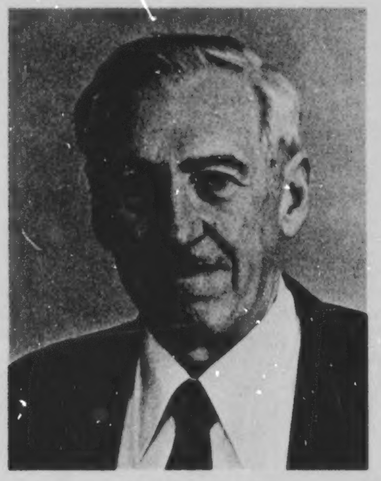

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ACADEMIC SUPPORT SYSTEMS: A NETWORKED APPROACH

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Academic support systems describes the growing class of university computing that are being developed to integrate and exchange information from both the academic and administrative computing environments. These systems may be typically characterized by the activities that center around a dean's office - office automation/information systems, institutional research, and electronic communication. This paper examines the basic design and implementation issues that are encountered in providing these support systems. The generic architectures are evaluated for their technical, financial and political strengths and weaknesses. Common implementation concerns such as security and telecommunications backbone are discussed.

One of the most important trends in university computing is the development of systems to manage information drawn from both the administrative and academic computing sectors. These connective systems, called academic support computing, can be characterized by a spectrum of services such as faculty scoring, computing, and registering grades from their home microcomputers, deans seeking statistical analysis of student population, and budget offices coordinating grant budgets with researchers. Reflective of a more managerial style in academic administration, this intersection of administrative and academic systems is a critical and difficult area, if only because of the clientele being served and the multiple interfaces required.

There have been several excellent reports on individual institution's approaches to providing academic support services, but there are few papers on ordering possible approaches within the broader framework of the institution's academic and administrative systems. This paper will focus on the generic design issues that need to be addressed by the organization providing the academic support services and how the rest of the institution's computing environments help shape the implementation. It is hoped that such a structured analysis may aid those who are also wrestling with the unique demands of this type of computing. While one specific architecture, a hierarchy of micros, minis and mains, is discussed below, it should be stressed that this solution emerged as best due only to a particular local computing environment.

The paper is divided into four sections. Section I discusses the components (and their interfaces) of academic support systems, distinguishing the activities that are more properly considered in strictly academic or administrative arenas. We also look at the underlying political, economic, and developmental needs that support systems must address. In section II, we examine the basic design issues that a systems planner faces. The generic academic support architectures are then analyzed with respect to these political, financial and technical factors. Implementation concerns are surveyed in section III. These issues are technical (e.g speed of links, compatibility requirements), financial (e.g. licensing of software, billing of network services) and political (e.g. user education, data ownership) stuff. Section IV presents some concluding remarks.

WHAT ARE ACADEMIC SUPPORT SYSTEMS?

The growth of university academic and administrative computing systems in both power and scope has produced a growing intersection of these activities. The intersection is marked not by shared activities but by shared data. Computations remain distinct; instructional and academic research computing continues to be the province of academic computing, and payroll and finance remain in the administrative domain. (In this paper, all these computations are grouped as the "primary systems", to reflect both their importance and their history.) However users of one primary system are increasingly accessing or wanting features on the other primary system. The prototypic situation is a dean's office (or associate deans on larger campuses). Almost every tool required in this office is becoming automated. Paperwork is handled by word processors and database or spreadsheet applications. Institutional research is conducted through downloading of administrative databases, often to academic systems which have the packages to do the statistics. Perhaps the most critical activity for the Dean is coordinating between academics and administrators; the considerable communication required is increasingly being performed electronically.

Other examples of the need for academic support systems abound. A faculty member familiar with electronic mail between his colleagues wants the same ability to communicate to administrative units when he assumes an administrative position. Crossover also occurs when a staff member takes a class and wants to use the administrative terminal on their desk to access the academic system for their assignments. These examples illustrate a key aspect of this type of demand - knowledgable users making sophisticated but reasonable requests.

Three broad classes of academic support services have emerged. They may be loosely labeled as: office automation/information systems, institutional research, and communications. The first category includes many of the "convenience computing" activities that are becoming prevalent, such as word processing, electronic spreadsheets, and the myriad office applications that respond so well to simple database packages. The most important aspect of this class for the academic support designer is the local origination and ownership of the datasets generally utilized in these situations. Such data poses less security and compatibility constraints to the rest of the systems. Another significant feature is that many of the applications are user-developed; appropriate central support is discussed below.

The increasing importance of the second category, institutional research, is indicative of the more managerial tone current in university administration. Calculations such as the relative cost of educating a student in different disciplines, comparative salaries by department, or the projected mix of students in 1988 are valuable statistics in planning and managing the modern university. Institutional research can be characterized by the eclectic sources of its input data, its passive but frequent use of institutional databases (such as payroll or SIS - student information systems) and the lack of need for its output data by the rest of the institution. For example, the data sources for determining educational cost per discipline includes budgetary databases, SIS, and capital inventories, while projections of student mix draws from such diverse sources as demographic studies, business employment trends, SIS, marketing analyses, etc. Where such research accesses university databases, it does so in read-only mode and often for only aggregated data. In addition, the results of the calculations are seldom accessible to other institutional units, so that "production" concerns do not apply. While security issues are somewhat more important in this category, local ownership and read-only accesses of institutional databases limits the vulnerability.

The third class of academic support systems is communications. There are many implementation of computer-assisted communication: electronic mail, digitized voice, voice store-and-forward, etc. Communications can be categorized by locus (intraoffice, interoffice, intercampus) with relative traffic ratios depending on factors such as campus geography, whether the school is part of a multicampus institution, and degree of national prominence. A second important view of communication is the time frame in which responses are needed, and a third major variable is the size of the average message. Such analyses are important in planning the communications and networking aspects of academic support systems.

Several recurring themes can be found in the above discussion. First, academic support systems is the intersection of two orthogonal computing styles. It is a clash of interactively-oriented academic computing and batch-oriented administrative systems, a traditionally more distributed environment versus a traditionally more centralized environment, an area the emphasis is on doing 'it' your own way meeting an area where the emphasis is on doing 'it' every day. Secondly, academic support systems seldom have a natural server. It does not belong purely on either the academic or administrative hardware, nor is it clear just who should manage this rather sensitive service. Thirdly, growing as an interface to existing academic and administrative systems, academic support systems must usually be retfofitted onto a diverse and often arcane set of compatibility conditions. Retrofitting is always a difficult task, and it is hard to design a powerful and flexible system that must conform to some archaic but required architecture.

DESIGN OF ACADEMIC SUPPORT SYSTEMS

The design of academic support systems takes place in a highly constrained and complicated environment. Typical difficulties include retrofitting to existing systems, the need for significant capitalization to provide the hardware for the services, and the politics of a visible and sophisticated clientele. We will examine some of these design issues in their technical, financial and political aspects; the mix of factors present in any situation of course is quite dependent on the institution.

Technical

Most of the technical design issues relate to the dual problems of providing the academic support systems vehicles and retrofitting these to the existing academic and administrative computing systems. Unless the academic and administrative systems share a common machine, the choice of a hardware configuration and the development of avenues back into the primary systems are the central decisions; secondary concerns include the telecommunications backbone, the degree and type of compatibility between user workstations, data ownership, and security mechanisms.

There are three basic architectures for academic support systems: embedding the services on either (or both) academic and administrative systems; using a separate 'mainframe' with interfaces to the primary systems and terminals to the user desks; and, at the far end of the spectrum, a completely distributed system where user stations are autonomous nodes on some network that includes the primary systems. Sharing hardware with existing systems is the easiest option technically, but few computing systems will admit to the idle capacities that the support systems will require. Using a mainframe (by mainframe we mean a large word machine capable of supporting a reasonable number of time-shared users) and terminals presents a straightforward technical approach. Total interfaces to existing systems is kept to a minimum, providing both security and reduced development difficulties. However, academic support system data is not kept locally, increasing other security issues. Similarly, compatibility of devices (e.g. printers, crts, etc.) and software is almost assured, though in general at some cost in flexibility to individual unit's needs. Communications capabilities are also facilitated by this architecture, and institutional data held by the support systems can be limited to a single copy, reducing redundancy (dangerous to the integrity of databases) and storage costs. At the other end of the spectrum is a completely distributed network of user workstations, typically microcomputers. Data is kept locally, securely, and often redundantly. Communications can be extremely difficult, especially with a variety of systems, posing a n squared solution. (It is unusual that even off-the-shelf communication systems such as ethernet will have identical implementations on a diversity of systems.) Similarly, the number of interfaces to existing academic and administrative systems goes from 2 to 2n, and security, compatibility difficulties, and complexity rises accordingly.

In practise, the weaknesses of the pure architectures can be resolved, and the stregths maintained, by use of a mixed architecture, where micros are netted through minis to the primary mainframes. As discussed below, such an implementation is flexible but with a high degree of compatibility and a limited number of interfaces to develop. The minis also provide the hub for communications.

The communications backbone must reach to every unit involved in the academic support system. The backbone may already exist if multiple site- multiple host multiplexing is used by either primary system, though security and traffic problems can result from piggybacking onto such a net. If there are local nets within buildings, then the backbone can consist of bridges from these nets into a central switch device. If a complete new backbone is needed, the designer will discover that, due to intersecting cost curves, telecommunication expenditures may easily exceed the cost of the systems being connected.

Financial

Regardless of the technical design, there are several common financial issues. The initial concern is the funding for the hardware, systems development and maintenance. Costs should be broken down into a one-time capitalization/system development and an ongoing system maintenance fee (which should include periodic system upgrades). Central systems offer uniform or pro rata cost schemes, while the distributed architectures offer the option of users purchasing their own workstations, which allows users to provide for their own needs. One particularly sensitive issue is whether new users be charged for initial system costs, and how new utilities are to funded. Group licensing of software faces the same problem; the marginal cost to a new user is often less than the charges incurred by the first purchasers.

Financing the telecommunications backbone and the interfaces to the primary systems is a second set of issues. The designer must specify a uniform "demark" point where user costs and responsibilities begin. Charging at this entry point can be based on several factors, including prorata costs, speed of link, traffic volume by bits or messages. (Some ports, such as bulletin boards, have asymmetric input/output volumes; whether one charges for input on output traffic is delicate.) To assure compatibility in communications, designers should specify a rigorous protocol that users must adhere to at the demark point. The level of the protocol depends on the architecture, but in general the specification should be to the transport layer of the ISO model.

Life-cycle cost analysis is deceptive in a field where prices are decreasing; it superficially seems worthwhile to continue to wait as prices to drop and performance improve. While replacements may pass a straight-forward cost-benefit analysis, the analysis for new functionality must attempt to calculate the lost opportunity costs of waiting for increased price/performance. Such calculations are always difficult to defend.

Political

Of course the academic support system must be designed within the political environment of the institution. The consequence of the clientele and the scope of the service increase the importance of the political design issues. Who provides the support service depends on the organization of the institution. Where one agency provides both the academic and administrative systems, the choice is obvious. In a multicampus institution with a centralized primary system, it is still desirable to provide the support systems locally. In a mature university with several fully developed departmental academic support systems, the role of a central provider (and the discrepancies between the haves and have-nots) must be carefully defined.

Because the users are generally sophisticated and knowledgable, the opportunity should be taken to allow them to assume greater responsibility for their data and resources (such as backups and security) as well as application development where appropriate. Besides the obvious benefits of removing impediments to user power, such users tend to be more understanding and supportive of the central systems. Similarly, these users have the confidence and the exploratory nature that create successful user communities. User education programs are vital parts of academic support systems, and are often self-sustaining at this level.

IMPLEMENTATION ISSUES

Many implementation decisions follow directly from a well-done design. However there are sume sets of issues best kept generic until system construction begins (e.g. speed of individual ports, location of shared letter-quality printers, etc.). In addition, RFPs may not come back as expected. Even worse is the computer analogue to the "round plug in a square socket" phenomena - when vendor performance specifications assume, but do not explicitly state, incompatible interface environments.

Viewing compatibility on a functional level leads to new interpretations of familiar terms. Hardware compatibility indicates that peripherals may be exchanged, offering a redundancy that is often valuable. Software compatibility means that a secretary trained on one work station can switch to another if needed. Data compatibility is perhaps the most critical in the academic support system environment with its propensity for information integration and exchange. It is increasingly important to be able to directly incorporate graphics or spreadsheets directly into text systems, to be able to use a familiar word processing editor while in electronic mail or to be able to consolidate spreadsheets across campus. Note that complete standardization on one text editor, one spreadsheet, one database manager, etc. gives no assurance of data compatibility or portability. Rather than face a combinatoric explosion of interfaces, it is best to standardize on a vanilla format (e.g. ASCII) and have each package provide an i/o utility to vanilla. (Of course, even vanilla has different flavors.) Data portability also requires an exchange medium to deal with incompatible disk formats, etc.; the communications support subsystem should have this capability.

Security is, of course, critical. It is also elusive in a university enviroment, with its high density of hackers. Ports into the primary administrative systems offer high vulnerability for the institution. One valuable technique is to restrict entry from the academic systems into the administrative systems to batch mode. Batch offers the best opportunities for security checks and journalling. Batch updates such as faculty entering final grades can be made to pass through critical filters in the academic support systems before entering the administrative system. Interactive read-only access to the administrative systems may be permitted, but more secure alternatives do exist; small high-priority batch utilities may be provided to fetch the data with little response degradation but increased scrutiny. In general the interfaces from the support systems into the academic systems may be fully interactive.

To illustrate these issues, we will describe the implementation of an academic support system at a specific institution, pointing out in parenthetic remarks the options typically encountered in such implementations.

A brief description of the institution and its computing environment: the University of Colorado at Colorado Springs (UCCS). Smallest (5000 headcount) of the four campus University of Colorado system. Traditional administrative systems (payroll, admissions, billing and receivables, etc.) provided centrally at the main campus at Boulder 120 miles away on an IBM mainframe. Academic services provided locally on networked DEC machines with a remote site terminal switching network to almost all buildings on a densely sited campus. No appreciable embedded base of departmental computers or word processors. Campus deans and directors are central figures with institutional research and governance both within the campus and between campuses. A single local computing services department provides the academic computing resources and operates the RJE and interactive terminus of the central administrative system.

This environment removed some design pitfalls (single computing organization, no embedded equipment bases to create inequities or incompatibilities) and exacerbated others (such as the DEC/IBM differences). The traditional weakness of the campus in word processing became a strength; hardware, software and data compatibility could be designed in, and word processing could be addressed by a multipurpose microcomputer. (To experienced word processors, the packages available on micros may be painfully primitive; to novices, however, it's sliced bread.) The central administrative systems provided economy and multicampus coherency.

A choice was made to build an academic support system through a micro, mini, and mainframe hierarchy accessible from a single keyboard. This architecture had several compelling virtues in the UCCS environment: Multipurpose office automation functionality for users who had no other equipment to handle any of these needs; major aspects of the funding assumed by users; flexibility; and decreased need for communication in a particularly costly telecommunications situation. The vendor choice on both the micros and the mini were logically limited by compatibility and staffing requirements to DEC and IBM; a DEC mini (VAX 750) was chosen because its compatibility to local systems, while micros have been confined to both DEC and IBM. (Departments may acquire other micros, but the demark point of other brands is the multiplexor port, while the IBM and DEC communications paths are maintained all the way to the user by the support coordinators.) Micros are being acquired by every top-line office down through all Deans and Directors.

The view into the micro's monitor reveals three distinct machines forming the academic support systems. Office automation and local information management are handled by the micro. Communications are run on the mini through terminal emulation mode on the micro; electronic mail extends to almost all academic and administrative areas both locally and on other campuses. Institutional research is done in several modes, one of which is the micro emulating an DEC VT100 which in turn emulates an IBM 3278 through a long-haul communications link from the mini to the central administrative system. The mini is also the RJE terminus of that long-haul link, so that batch jobs submitted to the central machine can return data to either the mini or the micro for research purposes.

Tuning the speed of the links between the micros and the mini led to several implementation options, including Ethernet and RS232. While the price of Ethernet has dropped rapidly, surprisingly the price of RS232 has dropped even more. Furthermore the traffic volume, while generally obeying the 80/20 rule, is a lesser consideration on a autonomous multipurpose microcomputer, where communication is just one of several activites. Lastly, the bursty but infrequent line activity meant that multiplexing RS232 could be done at a input-to-output aggregate speed ratio significantly higher than the standard 2:1. This higher ratio (at least 4:1) further improves the price/performance of RS232. The decision to use RS232 as the communications medium was termed "poor man's networking" but in retrospect turned out to be quite cost-effective in a system where file service is a secondary activity.

Equally important in implementation is the care and feeding of the academic support systems users. In general these users are extremely busy and have little "hacker" instincts; their interest is only in a tool that will save some labor. Like other novices, there is often a good deal of fear in these users; in addition they are usually confident and successful people who may have difficulty in admitting their fear (with the excuse "I'm just too busy to learn") and accepting instruction from a student assistant. These concerns should be acknowledged and user education should be focused in peer groups. Moreover there is an fallacious assumption by novice users that the machine, since it is billed as a labor-saving device, will give them significant amounts of free time. During the learning period (which may last as long as six months for an infrequent user) substantial effort will be required. Then, once past this period, the average user will find that as he can answer more questions with his system, he will naturally increase the applications he will tackle. The basic fact is that the user will do more because he can do more. Efficiency certainly improves, but that seldom translates into leisure time.

REMARKS

Several interesting observations have emerged from the design and implementation effort at UCCS. In our experience, we began by suggesting that users not buy hard disk systems, since hard disk price/performance is clearly the most rapidly changing aspect of micros. But the need for friendliness has revised this thinking; the complete menu approach without booting that is possible with hard disks is quite attractive to novices. Another lesson is that too many functions were embedded into a single keyboard. The lack of alternative equipment means constant competition for the multipurpose keyboard; either enough keyboards must be provided for all purposes or dedicated systems must also be acquired to offload some functionality from the academic support system keyboard. A third lesson is that portables and rentals are important to a successful implementation. Portables are extremely beneficial to a clientele that often have to bring work home. Rentals provided by the central coordinating agency may be necessary to bring critical but indigent offices into the communication net.

A second set of problems relate to the difficulties in maintaining interfaces to systems in which the academic support user is not the main user constituency. The primary systems constantly evolve in dynamics with their own users. The academic support systems must flex with these changes in an essentially passive relationship; it is politically unfeasible for the support systems to make demands on or resist changes of systems whose intent is to serve others.

Lastly, there are the caveats that all computing designers face these days: the twin evils of looking back (few have the perspicacity to fully perceive the current technological changes and their effects on users) or waiting in paralysis for the patterns to emerge (the only pattern is change); and Murphy's Law, which is quite prevelant in a discipline where micron precision is critical but the discrepancy in so-called standards is rampant.

The role of academic support systems will certainly increase in the next few years. Meeting its difficult challenges will be a continuing theme of university computing.

ACADEMIC INFORMATION MANAGEMENT -- A NEW SYNTHESIS

by

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ABSTRACT

Management in colleges and universities suffers from a general lack of decision support tools which provide decision makers with relevant, timely, activity centered information. While some segments of management in some institutions are using quantitative tools for modeling and decision support, the ability to extract activity or cost centered information from existing data bases is far behind private sector counterpart organizations generalizing on size of institutional budget and revenue flows.

The AIM concept is an attempt to serve three segments of academic management with data and models to support decision making. The management and evaluation of instructional computing in areas other than direct computing (data processing/computer science), the networked and comprehensive development of classroom support systems, and cost centered models with a focus on revenues and expenses (including cost accounting models) are the areas of development for the AIM system. The initial effort will be directed at the development of cost centered models for decision support. This paper describes the design concept and initial development phases of the system. Actual use of the system for decision support will begin in fiscal year 1984.

ACADEMIC INFORMATION MANAGEMENT--A NEW SYNTHESIS

by

Marshall Edward Drummond

Attempts to create meaningful information for strategic planning and decision-making from data that are a byproduct of an organization's accounting records is perhaps as old as the art of accounting itself. problems of timeliness, accuracy, and relevance have led the list of reasons why sophisticated management information systems (MIS) have evolved slowly.

The rapid spread of computers to perform accounting tasks, coupled with random access mass storage, brought promise to the development of computer-based management information systems in the early 1960's. The electronic computer was capable of providing timely information, but numerous obstacles inhibitied the development of cost-effective and easy-to-use MIS systems.

First and foremost among these problems was the almost universal computer "illiteracy" prevalent among top level managers of the day. This illiteracy inhibited communication between those who needed information systems and those who could develop them. Further, the necessary data were fragmented, segregated, and generally unavailable for use in any information system which might conceivably be developed.

Harvison and Radford (1972) aptly describe this obstacle:

> Usually, when the process of data base creation starts, the operation of each component system is under the control of the manager for who it was created. He directs the updating of files and decides on the distribution of outputs. Relationships with other systems are minimal, mainly because the use for which the application was designed did not seem to require greater reference to others.

This quote describes relatively well the state of the art of information management as recently as the early 1970's. Data files were captive of the application for (and the user by) which they were created. The first widespread use of the new database technology promised a centralized source of current data which was accessible to all users. Again, however, there were barriers to the use of these data. The communication problem between the executive and their technical staff was as great as ever, resulting in primitive database structures which were difficult to abstract or summarize quickly.

A significant factor which enhanced the development of management information systems in the late 1970's was the increasing number of young executives moving into key positions who were computer literate. These individuals, as a result, were well aware of the potential of MIS systems. Long and Brunn (1974) note, "leisurely long-range forecasting will become an increasingly insupportable luxury. Crystal balling won't become outmoded, but figuring out fast evaporating trends will involve an unmeasurable flood of ever increasing, rapidly changing variables." These statements place into perspective the change in management thinking which resulted from a rapidly advancing computer technology coupled with the educational enhancements of managers who were in positions of support to top executives.

Information Management in Business and Industry

The private sector began to capitalize on the data processing systems which were already in operation. The cost of such systems forced top management to be painfully aware of the costs of managing and manipulating information, while increased pressure for profits and productivity forced them to seek better alternatives for informed decision-making. The new cadre of computer literate managers were quick to point out the favorable return on investment which was possible with contemporary MIS systems. Relational data bases were on the horizon, and more rapid data storage and retrieval opened the way for the development of executive information systems.

Manufacturers of mainframe computers, e.g., IBM, DEC, Wang, etc., began to develop and sell mainframes which were conducive to data sharing, data base distribution, and meaningful data manipula-tion for executives. Intelligent and powerful executive workstations were developed. On-line query, graphics, and data analysis were provided--_if_ the entire configuration was designed for that purpose, _and_ a single manufacturer was selected to provide the system.

Rockart and Treacy (1982) cite testimony from a Chief Executive Officer who uses such a system.

> The system as been of infinite help in allowing me to improve my mental model of the company and the industry we're in. I feel much more confident that I am on top of the operations of our company and its future path.

180 Another CEO states:

> Frankly, a secondary but very real advantage of the use of the system by me is the signal it gives to the rest of the company that I desire more quantitatively oriented management of the organization. I want subordinates to think more analytically, and they are. I feel we're on the way to becoming a significantly better managed company.

Testimonies such as these are becoming more common among CEO's. These leaders will force the transition of systems and managers to a state of sophistication which was envisioned and predicted in the 1960's, but required the impetus of the "capital whip" to make it a reality.

The past several years have witnessed a new direction in the evolution of the MIS or EIS (Executive Information System). The rapid spread of microcomputer technology and associated software has given rise to a new breed of information user, who range from warehouse managers to CEO's. Relatively inexpensive hardware, coupled with an amazing variety of "user friendly" software, has fostered a literal explosion in the use of computing by a broad spectrum of personnel. Moreover, every conceivable type of organization, ranging from sports teams to corporate think tanks, has discovered the advantages of using computers to manage and manipulate their valuable information.

Despite these notable advances, a number of obstacles to efficient information management remain. Most new microcomputer applications can be described as (1) being supported on a variety of microcomputer hardware within a single firm; (2) begin run on a variety of micro-operating systems due to the variety of hardware; (3) being used on data elements which are keyed by the user of the model; and (4) not being widely shared between users within an organization. This type of computer modeling for management decisions could be termed "closet computing" due to the fragmented nature of users and their applications.

In many ways, the "closet computing" done by managers today is not unlike the departmental computing done by data processing departments of the 1960's and early 1970's. Its virtue lies in the fact that it is doing a better job of providing input for decision making than previous methods. The problems, however, lie in the segmented nature of the applications which open the door to errors such as data inaccuracy, poor algorithm development, relational oversights, and the obvious duplication of applications and effort.

Certainly, not all MIS or EIS systems have these defects. Some of the best systems are characterized by executive work stations which are upward and downward compatible with the host mainframe computer. DEC and Wang offer personal computers which are integral parts of their system networks, and IBM offers a number of intelligent terminal options and will probably integrate their Personal Computer with most of their product line.

Users who are not wealthy or fortunate enough to have a fully integrated MIS network can at least standardize their microcomputers and associated software so that: (1) standard data base interfaces can provide the needed data elements or aggregation of elements; and (2) standard spreadsheet algorithms can be shared throughout the organization so that executives are studying models built with the same assumptions. This would leave the MIS group with only the responsibility of maintaining the data base and necessary extracts to support the network.

Stibbens (1982) quotes an MIS director as saying:

> Control? I'm not concerned about having total control. I'm concerned more with everybody working off the same set of data. I'd rather be the keeper of the data and let everybody take copies to reformat it or do whatever they want but always come back to my organization for the raw data. Then we have only one place to go to keep it up-to-date.

Clearly, then the key concept is sharing common data and common assumptions about the nature of those data. The most successful MIS or EIS systems will feature the sharing of information and algorithms. This sharing is irrespective of whether the systems are based on a single vendor's compatible hardware or whether there is some common hardware standard imposed by the organization. Either approach will bring management based computing "out of the closet."

Information Management in Higher Education

The development of MIS in the private sector gives rise to an important question: what information management processes and quantitative methods have been employed to facilitate accurate decision-making in higher education? Herzlinger (1977) provides a relatively negative characterization.

> The state of control and information systems in non-profit organizations is dismal. Despite billions of dollars spent to provide relevant, accurate, and timely data, few non-profit organizations possess systems whose quality equals those found in large, profit-oriented corporations. Non-profit organizations do not lack data; if anything, they enjoy an over-abundance of numbers and statistics. Rather, they lack systematically provided information to help management do its job.

In the few years since Herlinger's observations, hundreds of nonprofit organizations, colleges and universities included, have necessarily changed their attitudes toward basic cost accounting. Scarce resources and decreasing enrollments in higher education have provided the catalyst for the development of MIS. In an attempt to reverse the trend towards fewer dollars resulting in poorer education, a large number of educational administrators have joined their private sector counterparts in becoming advocates of "closet computing." While not discounting the positive effects from this effort, the same difficulties which were mentioned in relation to closet computing in the private sector are and will be found in higher education.

Colleges and Universities are further hampered by the limitations on capital expenditures, which make it almost impossible to discard existing computing facilities in favor of installing a fully integrated, micro to mainframe system. This does not mean that educational institutions are in a hopeless position. Rather, it will require more of an effort by senior administration if a useful information management system for higher education is to become a reality.

The Need for an Academic Information Management System

There is no need to present a convincing argument in favor of improving the administrative decisions regarding the use of scarce resources in higher education. Books and journals are replete with articles documenting this need. None but the most heavily endowed institutions have escaped the realities of reduced funding, and few institutions can claim that they have met this challenge with better decision-making tools than were used before the crunch began. Instead, the typical reaction to reduced funding is some form of across-the-board or modified proportional funding cut for all units of the institution. Such wholesale reductions, however, take into account neither the relative import of these units to future "return on investment," nor the future vitality of the organization.

Given the lack of effective tools for information mangement, college and university administrators can hardly be blamed for not being more discriminating in their approach to resource allocation. The lack of meaningful modeling tools precludes informed decisions which are based on probability models, or which compare cost/benefit ratios in all possible permutations. In short, optimizing gives way to satisficing because there is no meaningful information from which difficult decisions can be made. The only budget cutting alternative is "everyone gives up a little." The result is that institutions move along the same path as they historically have, modified only by less of the same.

Quality of administration is perhaps the only universal solution to the "crisis" of quality in education. Massive faculty retraining or more rigorous core curricula are best viewed as cyclical in nature, while improved adminstrative techniques are linear, and can be counted on to produce consistently better academic results brought about by more effective planning and resource allocation. The concept of optimizing decision strategies offers the promise of emulating the successes of the private sector in the context of higher education. To say that an information management system will solve all of the maintenance and development problems faced by higher education in the United States would be naive. Nevertheless, to ignore the advantages of effective information management would be to ignore the teachings which have been disseminated from the educational institutions themselves.

The AIM Concept

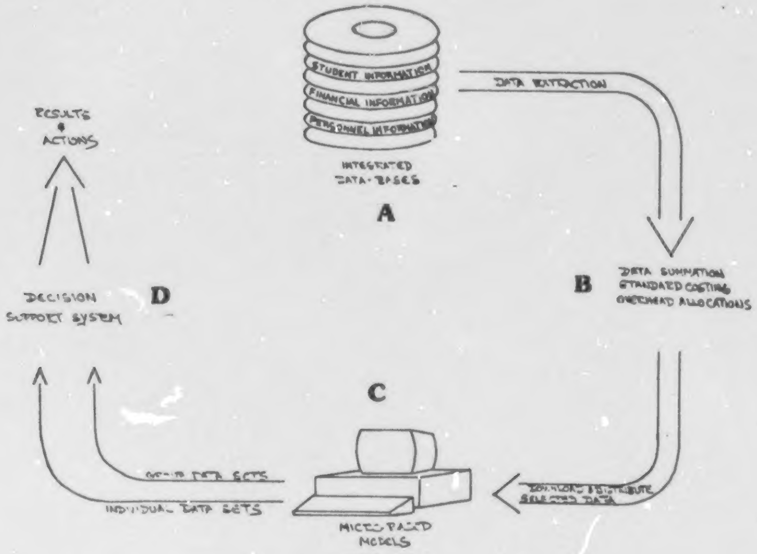
STUDENT INFORMATION
FINANCIAL INFORMATION
PERSONNEL INFORMATION
INTEGRATED DATA-BASES
A
DATA EXTRACTION
B
DATA SUMMATION
STANDARD COSTING
OVERHEAD ALLOCATIONS
DOWNLOAD & DISTRIBUTE SELECTED DATA
C
MICRO-BASED MODELS
GROUP DATA SETS
INDIVIDUAL DATA SETS
D
DECISION SUPPORT SYSTEM
RESULTS & ACTIONS

FIGURE - I

The AIM concept is bi-directional with one goal being the complete curricular integration of computing and the other goal being the ability to focus on cost-center models for planning purposes. The curricular integration of computing targets the untouched "middle ground" of curriculum which remains largely unaffected by computing. Students are instructed in data processing or computer science principles, and make use of computers for instructional support in some physical and social science curriculum. CAI is focused in limited curricular areas, leaving much of the task of computer integration throughout the curriculum up to the student. By this I mean that the student is expected to learn computing skills in computing courses, and then apply these skills to other diciplines. The instructionally oriented part of AIM addresses these issues by greatly improving computer access to students and faculty while making possible the use of innovative classroom management tools on a widespread, networked basis.

The cost-center modeling portion of the AIM concept will be the first to be developed. This segment of AIM, labeled EIS after it's industrial counterpart, will be used by cost center managers at all levels to plan and evaluate resource allocation as well as to determine the affect of the cost center's operation on the organization as a whole.

Figure 1 shows the relationship of an EIS to an organizations extant data base structure. This implies that the first order of business towards establishing a worthwhile EIS is to access the current state of organizational data. Time and computer operating constraints preclude the development of a time and cost-effective EIS using anything other than a data base structure to build upon. If your organization is not using data base technology, a timely and comprehensive EIS will be difficult if not impossible to achieve. In some cases, early heirarchical type data bases may present cumbersome obsticles to data base extraction and synthesis, but at least the data will be available in a composite, on-line source. The following description of the steps to be followed in the development of an EIS reference the data flow shown in Figure 1.

A. MAINFRAME DATA BASE EXTRACTS

The first step is to identify the data elements which are needed for the EIS. This means that the general framework for the models must be given consideration at this point. The organizations data element dictionary should be used to identify the required elements which will then be divided into two groups; one group representing elements for periodic extraction, the other group representing elements which must be extracted from the "live base" each time that they are used due to the need for absolute currency of data. Live data base extractions are to be discouraged unless they are absolutely necessary due to the system degrading nature of a large number of simultaneous on-line queries. Certain elements needed for models or decision support information will not be part of the "live base", yet the basic information required to compute these elements hopefully will exist. The basic elements will be extracted, the new elements computed and stored in a separate, newly created EIS data base.

B. EIS DATA BASE CREATION

The second step of the process is the creation of an EIS data base. This data base may be housed on a mainframe computer, or more ideally downloaded to a local area network mass storage unit. The idea is to provide managers access to a data base which contains all of the necessary elements for decision support without degrading the mainframe system response time.

Many of the elements for the EIS data base will have to be computed from existing data elements by applying certain algorithms at the time of the original extract. Examples of these elements would be course enrollment history data and cost accounting data. Course history on existing data bases is usually stored by term and section. For modeling purposes this history needs to be collapsed into elements which show aggregate enrollment by course broken down by location, and time of offering (day, evening, other). Cost accounting data must be computed from existing data bases to provide the EIS data base with data elements such as standard labor costs for various categories of faculty and staff, and overhead allocations by cost center. The process of cost accounting procedure development is key to the success of an EIS - and it is a process which must be worked out in a way that satisfies the needs of the specific organization which will use the cost data for modeling.

Once the costing formulas are agreed upon, the same process for data extraction and new data element computation will be followed periodically, probably weekly, so that the EIS data base will be current within agreed upon time constraints. Cost breakdowns which are in greater detail than cost center (breaking overhead allocations down to the course level) is best done at the micro-model stage of the process.

C. MICRO-BASED MODELS

The primary conditions underlying the development of micro-based models for decision support is that they: (a) draw upon a centralized EIS data base to insure data integrity and access speed; (b) utilize commercially available software for the actual modeling task. The only limitations on micro software selection are the degree of suitability to the modeling task and the ability to readily accept input data from external data sources. Once a model is conceptualized and put into the proper software format the link between the model and the EIS data base will be standardized and included in the model as a macro instruction. This linking step may require some technical support to accomplish, but once it is operational the procedure will occur automatically and be transparent to the user of the model.

Some data elements will have to be key entered by the user of the model. These elements, mostly those required for the "what if" questions such as inflation rate estimates, will usually come from data sources external to the organization.

D. DECISION SUPPORT SYSTEM

The elements of AIM which are required to support a specific decision will naturally vary dependent upon the overall decision environment. At times, the support will consist of single screen queries as have been used in the past. If multiple screen queries are needed, a macro instruction to extract all of the needed data at one time will result in multiple data sets, reformatted as needed and made available to the decision maker on a single "windowed" screen. This will eliminate the need to perform multiple queries to extract support data for a single decision. At other times, the results of models alone, or models coupled with queries will be needed.

The major advantage of the EIS system which is designed as described in this paper is that a manager will have the maximum decision support available in terms of models and data extraction with a minimal level of computer expertise required. Microcomputer operation and familiarity with the selected microcomputer software are the only requirements for use of the EIS system. Furthermore, the modeling software can be "prestructured" by technical support staff to perform the desired tasks, so the end user of the EIS system could use the standard models which he/she helped conceptualize, or the standard models could be modified to the end user's satisfaction with the assurance that the original standardized model could always be reactivated.

CONCLUSION

The reality of decision support systems for managers of educational institutions has been hampered by a combination of funding, the state of technology, and user knowledge of system design potential. The technological limitations have been mostly removed with the development of the large capacity microcomputer, the local area network, and integrated spreadsheet type software. The EIS segment of AIM simply takes advantage of these technological breakthroughs, and combines them with modeling, simulation, operations research, cost accounting, and other managerial techniques which have long been diseminated by the very institutions which stand to profit most by the installation and use of a cost-effective and timely decision support system.

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GATEWAYS AMONG ACADEMIC COMPUTER NETWORKS

by

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ABSTRACT

Academic computer networks in the United States are growing rapidly to support the expanding needs for computer-based communication of scholars and administrators in higher education. Both local area networks for intra-campus facilities, and national inter-campus networks are of great interest. This growth will accelerate in the foreseeable future as computers of all sizes spread rapidly through colleges and universities.

Individuals on campuses throughout the country are evaluating dozens of local area networking options to discover ways of satisfying voice, data, and video telecommunications requirements. Several universities have connections to more than five national networks. Most information technology managers are concerned about which network they should join, and several are building connections among different networks that serve their campuses.

Since there are no political forces to limit them in the United States, academic networks will continue to grow in size and to proliferate in variety. This growth will be compounded by the constantly decreasing cost of computer hardware. This proliferation has obvious associated costs and disadvantages. However, the newness of this field and the dynamic growth of new ideas are such that it is premature to try to restrict the growth with artificial means. Connections among networks offer the only reasonable short-term technical and organizational approach to the problems inherent in this proliferation. Commercial standardization, in the long run, will lead to computer networks that are interconnected in ways similar to present telephone networks.

This paper will focus on national, intercampus networks. Brief descriptions of several of these networks (ARAnet, BITNET, CSNET, EDUNET, MAILNET, RLIN, USENET, etc.) will illustrate the wide range of academic applications currently available, and the need for network interconnections.

THE COMPUTER NETWORKING ENVIRONMENT IN AMERICAN HIGHER EDUCATION

Definition

Computer networking, like many other technical concepts, is difficult to define well because it means many different things to many people. For the purposes of this paper I shall concentrate on networks having the following features:

- a system of interconnected, autonomous computers, terminals and communications facilities
- at least national in scope with significant academic usage
- availability of special software to manage resources in the network, and
- lists of host computers and users with their associated network addresses

Several important types of academic networks are beyond the scope of this paper (e.g. local area networks connecting computer systems on a campus, and regional networks serving a specific geographical area, such as a state). Many universities are in the process of wiring their campuses with different local area networks. For example, Carnegie-Mellon University is involved with a multi-million dollar joint study with the IBM Corporation to develop advanced scholarly workstations that are connected to each other in a high capacity local communications network. Dartmouth College is designing its own network to connect thousands of workstations, and Brown University has wired its campus with a broad-band network that carries both video signals and computer communications. The University of Chicago has installed a local telephone system that integrates voice and data on the same network, and dozens of other universities are experimenting with fiber optics and base- and broad-band technologies. Because of time limitations, this presentation will concentrate on national computer-based networks -- not on the equally exciting field of local area networks.

The term "network" is often used to refer to both a collection of computers and communication hardware, (physical network) and the groups of individuals connected by telecommunication links (logical network). A particular computer may be part of several different physical networks at the same time. More often, an individual will belong to more than one networking group, possibly on different physical networks. For example, a colleague of the author has six different network addresses, in addition to a postal address, on his business card.

Most higher education networks are based on the diverse needs of many individuals rather than on one underlying large system required to support the "business" of the institution. Such academic networks stand in sharp contrast to the high transaction rates and tight control structures of many commercial networks designed to support an organization's needs for reservation, order entry, and/or electronic fund transfer facilities.

Typical Academic Applications

In order to understand how computer networking is evolving in the academic community, it is useful to examine both the broad categories of applications most common today and those that are growing quickly.

Many important applications belong to the broad class of resource sharing uses. To replicate unique hardware, software, and data resources on every campus is prohibitively expensive. Consider, for example, the costs of operating the largest available supercomputers on many different campuses to satisfy the computational requirements of relatively few researchers. It is more economical to satisfy most common computing needs locally, and to access remote resources for important, but not heavily-used applications. The same argument can be made for sharing unique software and data resources.

Several successful networking applications in higher education have been justified using resource sharing arguments, but the actual number of such cases is fewer than was predicted several years ago. For example, a 1966 summer study of information networks conducted by EDUCOM reported:

> "Thus, a network could facilitate making the resources of one institution available to others. Universities could share library materials, data banks, computing facilities, ..."[1]

The rapidly-declining costs of hardware and the almost universal desire for local, even individual, control of information processing facilities, are two of the strongest pressures for localized computing capabilities. The relative lack of importance of academic resource sharing contrasts with many networks in the private sector where resource sharing is of paramount importance -- for example the strong motivation to share airline reservation information among many companies and passengers.

If resource sharing, although vital to some applications, is not the primary driving force in much of academic networking, what is? Communication among people is the obvious answer. Most academics must communicate with others to accomplish their goals. Since they are often separated from peers by large distances, and since the nature of their work is often collaborative and asynchronous, faculty, students, and administrators who have tried computer communication networks have, by and large, found them to be useful. Traditional communication channels (annual meetings, mail, telephone, etc.) do not have the needed capacity, or more importantly, the appropriate response time.

Many items are routinely sent electronically by people with access to computer networks -- short mail-type messages, reports, drafts of papers, data, programs, preliminary ideas, requests for comments and help, etc. Computer-based communication in networks has always been valuable, but often its importance was not freely admitted because it was not the primary reason for a network. Interpersonal communications are growing rapidly in all networks known to the author. Once many independent system components are in place, communication applications among previously disjoint elements are often important enough to justify networking. The widespread use of computer networks for communicating is causing new forms of computer-based communication services to be developed. Electronic bulletin boards and sophisticated conferencing systems are two examples popular in higher education.

SIX ILLUSTRATIVE NETWORKS

ARPAnet

In the late 1960s, the Advanced Research Project Agency of the U.S. Department of Defense established a basic research effort in computer networks. ARPA (now DARPA) made several grants to corporations and to academic computer science departments to help develop the field of computer networking. This research led to the implementation of a small prototype network in 1969 that has grown to approximately 100 nodes (and almost 200 computers) distributed throughout the U.S. and several other countries. These nodes are connected mostly by leased telephone lines, and in a few cases, by leased satellite channels.

Many of the important concepts, such as packet switching, commonly used in several operational networks, were developed by these research projects. The results of these developments had immediate positive impacts on the computer science community, and ARPAnet became very popular within colleges and universities. In a technical sense, ARPAnet is the real father of modern academic networking in the United States.

The host computers were those involved in research projects supported by DARPA. Thus the early ARPAnet served two primary purposes -- it connected an important group of computer scientists who were working on problems of interest to the entire group, and it served as a pioneering research vehicle for development work on networking. A. Newell and R. Sproull report that:

> "(ARPAnet) hosts still represent the full spectrum of university and industrial research groups in computer science, but also now include numerous military organizations with diverse operational missions. The network is essentially saturated....... The traffic consists largely of mail messages and files, the latter containing programs, data, or text. There is substantial remote access, and several organizations use the net to do all of their computing remotely. The use of the ARPAnet has become integral to the operation of many of the organizations connected to it."[2]

A problem of ARPAnet in higher education has been its strict policy of limited access. Since it served both research and operational Defense Department roles, ARPAnet has not been able to expand to satisfy the needs of academic computer scientists who are not part of the DARPA community. In 1983, APRAnet separated the research and development activities from the operational activites and created two distinct networks. ARPAnet has obviously been unable to expand to accomodate faculty in other disciplines.

CSNET

Because of ARPAnet restrictions on membership, the University of Wisconsin at Madison, on behalf of 15 other participating institutions submitted a networking proposal to the National Science Foundation. In January, 1981, NSF approved funding of approximately $5 million for a computer science research network (CSNET). CSNET is a computer science community effort to provide open network services throughout the United States to computer scientists. There is cooperation between the Department of Defense and NSF to allow message communication between CSNET users and ARPANET sites. Presently 19 CSNET members also participate in ARPANET.

At the end of 1982 there were about 70 participating sites in the first phases of CSNET. An NSF program solicitation for an organization to manage, operate, and develop CSNET, describes the network as follows:

> "The Computer Science Research Network (CSNET) is a project of the National Science Foundation that is intended to provide network services and access for all qualified computer science researchers. It is a logical network utilizing the services of several physical networks.... Over the long term, CSNET must meet the network needs of the computer science research community sufficiently well to generate its own financial support......"[3]

CSNET is growing rapidly among computer science departments. There are three major kinds of services the network will eventually offer:

- network mail including an addressing (directory) facility
- file transfer from one CSNET host to another
- remote login, the ability to use a remote host as if it were local.

EDUNET and MAILNET

In 1979, EDUCOM, a non-profit consortium of a more than 450 participating colleges and universities, announced the operational phase of EDUNET, a computer network that was founded to meet the general networking needs of higher education. The design of EDUNET came from the work of The Planning Council on Computing in Education and Research which was composed of about 20 universities. The Council met for several years to study the kinds of networking arrangements that could best lead to a self-sustaining organization capable of providing viable academic network services. The Planning Council grew from ideas developed at three seminars conducted in late 1972 and early 1973 by EDUCOM with the support of the National Science Foundation.

EDUNET's primary focus has been to make it easy for people located throughout the world to interact directly with sophisticated computer resources supported by 19 host institutions.

EDUNET has evolved into an international computing network for higher education, research organizations, and not-for-profit companies. To promote the sharing of computerized resources, EDUNET provides access to specialized programs, services, and databases of 18 leading university computer centers in the United States. In addition, the University of Stockholm, Sweden recently became the 19th, and the first international, supplier.

Typical services include electronic mail and conferencing, access to unique computer hardware (e.g., the CRAY-1 supercomputer at the University of Minnesota), database management, modeling, and hundreds of programs in topical subject areas. EDUNET services are used by administrators, faculty, and students in more than 150 participating institutions. Services can be accessed through terminals, microcomputers, and word processors with communications capabilities. Local access is available in 250 U.S. cities and 30 foreign countries through public data communication companies such as Telenet and TYMNET.

Electronic mail and computer-based conferencing are the fastest growing services provided by EDUNET suppliers. A new EDUCOM activity is MAILNET, a project to transfer the electronic messaging facilities developed by the CSNET project beyond the computer science research community to all of higher education. MAILNET will link together local campus-based electronic mail systems to support transmission of messages and documents between persons on different campuses -- all of whom use their own local electronic mail systems. Virtually any campus electronic mail system may connect to Mailnet regardless of the type of computer or operating system used.

At the present time, 14 universities are connected directly to MAILNET, including sites in the United Kingdom and Sweden. Ten more universities are in the process of implementing direct connections, and by this spring, well over 100 colleges and universities will be addressable by network gateways.

BITNET

BITNET is a rapidly expanding network of more than 100 computers located at approximately 40 universities. The first link was established between The City University of New York and Yale University in May 1981. The network is based on a software product developed and used internally by IBM to support a multi-national internal corporate network (VNET) of more than 1,000 nodes. The software provides store-and-forward message capabilities. The only special networking hardware required is a modem and a leased telephone line to the nearest BITNET host.

In the past, BITNET software was available only on IBM computers, but recently the communication protocols were developed at Penn State University to enable several kinds of computers made by Digital Equipment Corporation to be part of BITNET. Ira Fuchs, one of the organizers of BITNET, describes it in the following way:

> "The primary purpose of BITNET is to facilitate communications among universities by lowering the threshold of effort normally associated with other means of exchange. BITNET was designed using simple,

> inexpensive software and cost-effective telecommunications facilities. Thus an institution can connect to BITNET easily, with negligible programming effort and cost, providing speedy and simple access for faculty and staff. BITNET users share information via electronic mail, specifically in the form of interactive messages, text files, and computer programs."[4]

One of the interesting aspects of BITNET is that there is no central management of the network, or paid staff. Each site pays for the cost of the telephone link to the next BITNET site. The administrative, technical, and operational costs of running the network are shared by each participating organization. BITNET will soon extend into Canada, and a direct link to Europe is currently being implemented.

USENET

USENET, an informal network of more than 500 computer systems running the UNIX* Operating System, is similar in many ways to BITNET. Several years ago students extended a communications package that is part of the UNIX system to include a news facility. This facility is really an electronic bulletin board to which sites may subscribe for various services ranging from news about data communications and microcomputers to wine tasting and jokes. An extensive electronic mail facility is a part of USENET. Systems can enter and leave USENET very easily since there is really no central administrative structure. One drawback of the informality of this network is that users must know, and specify, valid routings through the network to reach users at other sites.

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* UNIX is a trademark of Bell Laboratories.

Library Networks

There are several important library networks supporting activities in higher education that are very different from those described in the preceding paragraphs. The largest of these networks is OCLC which was established in 1971 to provide cataloging support to libraries in Ohio.

The organization has now grown into an international network serving all types of libraries. Several regional networks collaborated with OCLC to spread its services throughout the United States and into Canada and the United Kingdom. Two other major bibliographic systems have emerged in the United States -- WLN, the Washington Library network, and RLIN, the Research Libraries Information Network.

It is beyond the scope of this paper to explore these networks in any depth, but they must be discussed briefly because of their uniqueness and importance. These networks have emerged not along discipline lines like CSNET or COGNET, nor because a technology was available like BITNET or USENET, but because of functional specialization and the need for resource sharing on a grand scale. Large bibliographic information retrieval systems face many of the problems of other networks, and in addition, they have specialized technical and legal concerns. For example, there are very complex legal, political, and economic implications concerning the sharing and exchange of bibliographic data among operating libraries. Who owns the data and how may it be distributed? Many of the organizational and technical developments in this field are such that precedents and ground rules do not yet exist.

Several companies provide abstracting and indexing services that are widely used in higher education in addition to other market areas. These services are usually provided through campus libraries with trained staff members serving as the interface to the information retrieval networks.

FUTURE TRENDS IN ACADEMIC NETWORKING

Since there are no political forces in the United States to limit the number of different academic networks, the author believes they will continue to grow in size and to proliferate in variety. This growth will be compounded by the constantly decreasing cost of computer hardware. This proliferation has obvious associated costs and disadvantages. However, the newness of this field and the dynamic growth of new ideas are such that it is premature to try to restrict the growth with artificial means. Gateways among networks offer the only reasonable technical and organizational approach to the problems inherent in this proliferation.

Several inter-network academic gateways already exist, and others are under development. For example, ARPAnet and CSNET have been closely linked from the beginning. Recently computer scientists at the University of Wisconsin designed and implemented a gateway between CSNET and BITNET that is being tested. Developers at the City University of New York and the IBM Cambridge Science Center designed and implemented a gateway between BITNET and VNET, the internal IBM multi-national network. This gateway had to pass rigid security tests imposed by IBM before it became operational. A gateway between a network of several universities using DECnet and BITNET has been operating successfully for more than a year, and a gateway between MAILNET and BITNET is currently being tested at Cornell University.

Most of the technical problems with the design of successful gateways among networks have been solved, but large organizational problems remain. For example, internetwork addressing standards have not yet been widely adopted, and many of the current solutions are too informal and ad hoc. Another organizational problem is internetwork pricing and charging incompatibilities. Most networks charge users for each message, but some (e.g. BITNET) have no variable charges for traffic. Clearly these different pricing philosophies cause problems when internetwork traffic begins to get grow.

Computer networks will eventually interconnect as smoothly as current telephone networks. Corporations will offer increasingly more valuable services, and discipline-based networks will probably not manage and operate their own long distance communications links. If one technology or service emerges that is clearly superior to, and more economical than, all others, it will be widely adopted for new applicaitons. However, successful older networks will continue to exist for a long time.

Network information and management centers are emerging to formulate solutions to these problems. For example, BBN Inc., a Cambridge Massachussetts firm, operates a Network Information Center for CSNET. EDUCOM and City University of New York are working together to develop a joint Network Support Center for BITNET. EDUCOM will supply user service facilities to the rapidly expanding academic networking community, and City University will develop needed software and operate a Network Support Machine that will provide important facilities such as network address information for users and directories of software and hardware resources. This proposed Network Support Center will also coordinate the design and operation of gateways among BITNET and several other academic networks including a BITNET link to Europe which will become operational this spring.

Computer-based networking activity is beginning to expand between the United States and Europe. Several interesting networks exist in the European higher education community, and efforts are underway to expand gateways to American networks. It seems obvious that academic networking connections between the U.S. and other countries will grow in importance as the technology evolves. Of course, the most important incentive to this growth will be the emergence of groups of academics in different countries who want to use computer networks to communicate. The technology is ready and waiting to support such international cooperation.

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Personal Computer Communications

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Many universities need to use personal computer systems either as terminals or as distributed processing workstations. There is an ever growing demand for information to be transported from the "main computer" to a user site, or vice versa.

This paper will discuss the interconnection between personal computers and other personal, mini, or mainframe computer systems. Hardware techniques for tying computers together, a description of the software available and advantages and disadvantages will be presented.

In addition, we will take a look ahead to the emergence of sophisticated micro/mainframe links with major software systems and will discuss strategies for data sharing and the role of the Information Centre. A brief review of products we have tried and are using at McGill will be presented.

A year ago, my department, McGill University Management Systems, adopted a support policy for personal computers (PC's). We standardized on the IBM PC, and encouraged administrative departments to use PC's. At that time there were only three personal computers in use for administrative applications. Today, that number has increased to 25 and is steadily increasing. Several of these users have requested that Management Systems provide them with a way to link their PC's to our large mainframe based systems.

Personal computer users want to communicate with other PC's, minicomputers, or mainframes to exchange information and messages with other users, and to share common data and devices. There are several ways to accomplish these objectives. A simple way to exchange information between users and systems is with paper. Some of our first PC users wanted to provide us with input to update programs from data entered on their PC's. For example, they might have the data in the form of a spreadsheet. A simple solution to the problem of getting this data into our system was to have the user print out the data in the form of a neat listing, and then our data entry group took over. This works very well for ad hoc requests, or small infrequent batches of data, especially if the data was previously provided on handwritten graph sheets!

Obviously, it is desirable to avoid the re-entry of data already in machine readable form, and to eliminate the possibility of data entry errors taking place. A second way to exchange information stored on a PC is via diskette. Diskettes are compact when compared to paper, and can be mailed. Two PC users can easily exchange data in this way. The MIS department could also accept diskettes, and transfer the stored information to its computer system over a communication link (more about this later). The problem with diskettes however, is handling and media compatibility. Diskettes are easily damaged by rough treatment and stray magnetism, and don't travel well unless carefully protected. In addition most personal computers cannot read diskettes created on a personal computer from another manufacturer. Like paper, diskettes must physically travel from one point to the next, and this can take time.

A better way for PC's to communicate with other computers is over wires. For casual telecommunication, the wires may belong to the telephone company. For more dedicated use, either a major network, or local area network can provide a path for the flow of information. The use of an electronic, wired communication scheme avoids the shortcomings of physical methods like paper or diskettes, such as handling or distance. In some cases electronic communication can solve the problems of incompatibility, and errors during transfer.

For casual communication between PC's or between PC's and larger computers, asynchronous (start-stop) telecommunication works well. This kind of communication is generally point to point (two computers linked to each other), and takes place over public telephone lines or twisted pair wiring (a fancy name for wire like that used by the phone company). Signalling between devices is done using the common RS-232 interface standard, and except for very short distances, modems are used at both ends. Examples of this sort of communication would be a teletype terminal hardwired to an IBM mainframe, or a VT-100 terminal dialed to a VAX minicomputer over the telephone system.

Telecommunication is the first approach tried by PC users. The hardware requirements are a PC with RS-232 communication, and a modem. Most PC's are purchased with a RS-232 port (often on a combination card), and modems can be bought for very little or may already exist within the user's department. In order to be up and running, some software is needed to make the PC communicate. The software makes the PC act like a "dumb" or "smart" terminal, as this is what the other computer (host) expects. Examples of this kind of software are: Crosstalk XVI, PC-TALK, IBM Asynchronous Communication, etc. Literally dozens of these software packages exist. Important features to look out for are: ease of use, ability to emulate popular terminal types and file transfer (upload, download) capability. Other features include flexible parameter setting (so that you can customize), high speed (for local attachment), and automatic operation (automatic log-on, automatic answer). With automatic answer the PC can act as a host system to other PC's, or run a bulletin board service (BBS).

The main advantage of telecommunication is that it is easy to accommodate, and it is inexpensive. Most colleges and universities can easily adapt to this communication scheme, as it relies on existing telephone wiring, and commonly used modems. Although it works reasonably well, and distance is no barrier, the software can be tricky to use. There are many different host systems that all work a bit differently, and many kinds of hardware are involved. At first, the user tends to be confused about what options to select from the choices provided by the software packages. After the initial connection, things tend to work well as long as the user sticks to one host system, and the host system does not change procedures too often (log-on sequences, etc.). File transfers often prove to be especially frustrating, as they often rely on the user understanding the host system's editor, file conventions, and so on. Other disadvantages of telecommunications are weak error detection schemes, and the slow speed of communication. But in all fairness this method is fine for casual use.

Major dedicated networks support the interconnection of many devices (multipoint). These networks are usually mainframe oriented, with a central mainframe tied to a large periphery of terminals or remote job entry stations. Wiring is usually coaxial cable or twisted pairs. Either synchronous or bi-synchronous (BSC) data transmission is used (which are more complicated than asynchronous, and use timing "synchronization" for data decoding). Cluster controllers and synchronous modems are normally used to connect devices on the network. An example of this kind of system would be an IBM mainframe supporting a network of 327x terminals, perhaps using SNA, or SDLC protocols (network software).

The second approach to communication usually involves the major networks. University campuses already have such networks already in place, serving both academic users and MIS. For this reason, the MIS department is usually attracted to linking PC's in this way, as the network and expertise are well established. Hardware required to allow PC's to hook into the network comes in the form of a special communications card to plug into the PC, such as the AST 3274 SNA card, or the TAC 3278 Irma card. The software required for terminal emulation is provided with the card, and allows the PC to be immediately inserted as a terminal into the network. Beyond this terminal emulation, (which has limited value), sophisticated software that integrates with the host software is required for file transfers or distributed processing. Recent examples of such software are beginning to emerge, with packages like: Tempus-Link, Omni-Link, PC Link and others from firms well known in the mainframe market - On-Line Software International, McCormack & Dodge, Informatics, Cullinet, Focus. These packages provide the user with transparent file transfer (virtual floppies), data provided in the form of popular packages such as Lotus 1-2-3, or links to large data base management systems.

The major network approach has the advantages of using the existing network and expertise, good performance, and a higher level of reliability than casual telecommunication. On the negative side, equipping each PC is more expensive than it is for asynchronous RS-232 communications, and it is not easy to justify placing a PC on the network if it cannot do more than a terminal can do. PC's are still considerably more expensive than 327x terminals when equipped with the communication card. To fully utilize the PC's potential, an integrated micro-mainframe link is required. These packages are very new, and are still being refined. At present they still represent a "kluge" approach.

Local area networks are a recent development. These networks provide for multipoint interconnection of devices. Usually the device is a personal computer, as local area networks (LAN's) are distributed data processing (DDP) oriented. DDP means that the computing load is decentralized (closely matching the flow of work), rather than centralized in location. The wiring is usually coaxial cables or twisted pairs as in major networks, but the layout of the wiring (topology) is usually different. Whereas major networks are usually wired like a star or a tree, LAN's are usually closed loops, or open-ended chains. They are called "local" because they usually do not involve more than two kilometres of cable, are are generally restricted to a single building or office complex. Some of the more popular networks are: PCnet, Omninet, Nestar and 3Com Ethernet. A good discussion of PC networks can be found in the November 1983 issue of PC magazine.

The local area networks provide a new way to communicate. In addition to information exchange, they permit data and device sharing, and are an excellent vehicle for DDP. Hardware requirements consist of a network interface card for each PC, and a network controller which could be one of the PC's in the network, or a specialized microcomputer. This controller, or server, may also be attached to expensive devices that other PC's in the network can share; hardware like hard disks or high speed printers are good examples. Software to run the network comes bundled with the network hardware, and may include features like "electronic mail" for user message exchange.

A primary advantage of the LAN is speed. The networks themselves can handle data rates of up to ten million bits per second (BPS). In practice however, such rates are not attainable with the memory and input-output speeds of current microprocessors and disks. The LAN creates an ideal atmosphere for distributed processing through data and device sharing, and their open-ended design allows for new PC's to be easily added to the network as the need arises. The major disadvantage of LAN's are their newness. It seems that almost every LAN in actual operation is a beta test site (the user gets the bugs out for the manufacturer), therefore these LAN's are not yet fully reliable. They are also fairly expensive, and each network is incompatible with the others (so what else is new?) The present level of software does not provide a true multi-user environment, and care must be exercised to prevent users from crashing the network or corrupting files. In spite of this, networks offer tremendous promise in the years ahead, and are well suited for use in the somewhat autonomous and localized nature of college and university administrative structures.

At McGill we have tried various means of getting our PC's to talk to other computers. Presently there are 25 PC's used for administrative purposes. For casual telecommunication we have tried the IBM asynchronous communications card, the AST ComboPlus card with on-board asynchronous communication, the IBM Asynchronous Communication program (versions 2.0 and lower), and Microstuf's Crosstalk XVI communication program. In both cases IBM lost out, we now equip all our PC's with the AST card, and use the Crosstalk package. The AST card offers memory and I/O, makes economic good sense, and takes only one slot. The crosstalk package does everything we expect it to do, is fairly easy to use, has good file transfer ability and is quite fast.

We have a network of 105 3270 type terminals which are used for our on-line systems (IMS, TSO and MUSIC). Into this network we attached a PC with an Irma card from TAC, and found it served as a satisfactory 3278 terminal. The software did not provide for any file transfers, but this is presently being rectified by TAC, and new software upgrades have been announced. Some BASIC program calls were provided for user-written file transfer routines, and we tried writing some of these, but the results were poor, as even a compiled BASIC program ran too slowly.

The only local area network we have tried is PCnet, with two machines. The documentation was rather poor, and the network did not work due to a conflict with hardware interrupts. A later release of PCnet provided the user with a means to select interrupts, and we tried this as well. This got PCnet working, but there were still some problems with sharing a printer and using BASIC. Part of this was the fault of BASIC, which tends to take shortcuts and bypasses the disk operating system. We are presently fence-sitting, and waiting for networks to mature. Our sister university in Montreal, Concordia, is using the Nestar network with 20 student PC's, and it is running well.

In addition to hardware on the micro end of things, we also have two protocol converters at the mainframe end. These allow remote users with terminals or PC's emulating terminals to dial in and emulate full-screen 3270 type terminals. This works, but remote access is slow, and the emulation and conversion add considerable overhead and complexity to the communication.

Our eventual goal is to get our administrative PC's communicating. Our users would like to access data stored on the mainframe, and use it on their micros. They would also like to transfer data from their PC to our mainframe. Providing this kind of service requires a data distribution strategy. The key issues here are: accuracy, security, and back-up of data. We are concerned about providing data to users that could quickly become out of date, or be misused or wiped out. In order to establish a strategy and a method, the creation of an Information Centre within the MIS department is appropriate. The Information Centre provides users with training, advice, and access to data on their own terms. The Information Centre staff works with the Data Base Administrator, and selects the appropriate software to get data to the users.

An example of such software is Tempus-Link from Micro Tempus Inc. in Montreal. Tempus-Link provides PC users with "virtual floppy disks" which are actually VSAM files on the mainframe. About 100,000 lines of code on the mainframe, and 2K of code on the PC are involved in this micro-mainframe package. The software also provides utilities to allow the MIS department to download files to PC's at night, keeping the PC files current and accurate. Once data is extracted from MIS files, it can be encrypted, so that it cannot be misused. Operating in reverse, it also allows the MIS department to upload PC user files at night to the mainframe for secure back-up.

A look ahead to the future, brings a vision of many improvements in PC communication. In October IBM announced the 3270 Personal Computer, and the XT/370. The thrust behind these new products is to tie together the various elements of computing and office automation, with the PC serving as the user workstation. Greater integration of micro and mainframe technologies should result. With major networks supporting PC workstations, and local area networks, DDP may become a reality at last! The public telephone companies are also entering the fray with a switch to fully digital phone systems, and fibre optics. In Canada, Northern Telecom is researching a concept called the "Open World". This idea revolves around the use of the SL-1 telephone system to fully support digital data communication between every conceivable information device. Data transmission speeds of one million bits per second on ordinary phone wiring are operational in the lab. The future of PC's and computer communications is indeed a promising one.

MAINFRAME/MICRO CONNECTION--THE USER'S VIEW

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Many computer vendors are currently offering microcomputer workstations which can be "integrated" with their mainframe computers. Popular advertisements suggest that virtually any microcomputer on the market today can "interact" with virtually any mainframe, for any application. This article discusses the functional needs that users have for micro/mainframe linkage and identifies the technical issues involved in meeting those needs.

MAINFRAME/MICRO CONNECTION--THE USER'S VIEW

As President of a twenty-thousand student urban community college my primary concerns have focused on academic and educational issues. However, more recently, with the fiscal climate currently prevailing in California, I am spending more time as a business manager in a business operating on a very tight margin. I am responsible for fiscal, human, plant, and materiel resources and I must operate an efficient, cost-effective organization if I am going to create a high-quality product in quantity within tightly constrained resources. I cannot afford to miss any opportunity to increase access to information to help me organize my institution and plan for its operation. Microcomputers, interacting with traditional mainframe computers, represent a valuable resource for collecting and manipulating the quantitative information which, in my judgment, is the foundation for successful business management.

Automated data processing systems -- financial systems, payroll/personnel systems, and, perhaps most importantly, student information systems, have improved the efficiency of operation in higher educational institutions substantially. The benefits of automated data processing falls primarily into three areas:

o. More efficient processing of routine activities such as funds disbursement, registration, and preparing and disseminating transcripts.

o. More accurate and more complete tracking of operational data used for auditing, state reporting, and student enrollment and transcript information.

o. Routine reporting of useful information to monitor on-going activities such as new registrations, current fund encumbrances, allocations and budgets, and faculty and student placement patterns.

I dare say that not one institution represented in this audience has failed to profit from the benefits of automated data processing in these areas.

Automated data processing has increased efficiency and accuracy in management. In a sophisticated data processing environment which features on-line administrative systems, a terminal on a manager's desk can provide immediate information on class enrollments, student profiles, financial statements, faculty work-loads, registration totals, etc. Planners and decision-makers hold high expectations for the contribution of these systems to effective planning. All of this data is now collected in one central location. Creative use of that information should facilitate effective leadership.

Unfortunately, these expectations are usually not met. The on-line data are presented in rigid formats and include only historical information or current status reports. Numerous routine reports are printed which are defined to satisfy needs of external agencies. The frequency of the reports is often defined by a legislative calendar rather than by the dynamic needs of decision-makers. In current administrative data processing systems, the data are organized to support administrative processes rather than creative planning. I know to the penny how much financial aid has been disbursed at any given moment, but I do not know what proportion of that financial aid has gone to minority or handicapped students. I know how many students enroll but I do not know what courses a student is taking, how many units he has elected, or his ethnicity.

While process within an organization is usually rather static, the needs of decision-makers are not. Planners often need to integrate data developed in diverse administrative offices. Currently, for instance, I require detailed information on program costs which involves detail data from our fund accounting system, our payroll system, and our student information system, organized so that I can understand the per-student costs of our various programs. I need to determine the marginal costs of additional students. And I need to identify the constituent costs of programs -- faculty costs, costs for special facilities, costs hidden in other programs because of required service courses, etc.

As a planner, I need more than simple answers to factual questions -- I need to be able to speculate about the consequences of possible decisions. Does a program become cheaper per student with larger enrollments? If so, what are the break-points? Beyond that, I would like to link my programs with student placements and job opportunities. I need to compare the costs of different programs, in light of the mission of my college and the placement profiles of our students, to determine where to cut, and where to augment, programs. I should be able to create models of my institution with new programs added and very different curricular mixes than we currently support. I believe that, fundamentally, higher educational institutions today are driven by economic factors. Only by creating dynamic economic models can a decision-maker effectively plan for the future.

New microcomputer technology presents an opportunity to bring the power of automated data processing to the decision-maker. Most, if not all, the data needed for effective planning is currently being trapped through on-going administrative processes. What the microcomputer adds is the capability for the planner and decision-maker to access the data and manipulate it for his or her purposes. A number of microcomputer programs are both powerful and easy to use, thus allowing the planner to remain "close" to the data and prepare complex models without becoming mired in programming tasks.

Computing is entering a new era. Soon I will have a microcomputer at my desk which provides three computing environments:

- o. A terminal which can perform as a common data entry and inquiry terminal to administrative systems.
- o. A stand-alone microcomputer which manipulates data which I enter myself.
- o. A microcomputer able to process data stored within the administrative systems.

I obviously do not need a microcomputer to serve as a terminal to the administrative systems residing on a mainframe computer, but it is far more convenient to have a single computer station at my desk than to have both a microcomputer and a mainframe terminal.

Among the applications I now use on my stand-alone microcomputer are wordprocessing, spread-sheet analysis, data storage and retrieval, and a wide array of educational programs. Our Independent Learning Center is now developing a system using a barcode reader to track student activity within the center on a microcomputer. Wordprocessing on microprocessors has become widespread among both the administrative staff and the faculty at large. I expect that soon students, too, will be using microcomputers for preparing their assignments.

Valuable as microcomputers are in their stand-alone mode, the real power of microprocessors reveals itself when they are integrated into a sophisticated computing network. Data created at one microcomputer station is available at all other stations. One file can support programs at many locations, and one database can track information input from various offices.

Complete integration of the microcomputer into the administrative systems network, in addition, allows the manager to extract data from the administrative database and manipulate the data. Thus I can ask questions never before asked of the mainframe data, and quickly receive answers. I can download budget information and execute "what-if" analyses reflecting the financial implications of diverse policy decisions.

I can develop a program-costing profile of my campus expenditures — not currently reported in any of the formal data processing reports — and then create alternative models. I can analyze student enrollment data to identify historical trends and create alternative enrollment projections to plan for future college needs. Using data from external sources, I should be able to compare curricular costs and placement statistics with profiles of the local marketplace.

Currently, the technology of integrating microcomputers into mainframe computing networks, as required for the most effective application of the local processor to solve a policy maker's problems, is difficult. Although there are a few prominent examples of mainframe/microcomputer integration, most educational institutions with sophisticated administrative systems are finding that such integration is very difficult.

At San Diego Community College District, which uses a Univac 90-80 for administrative computing, we have not yet successfully integrated microcomputers into the administrative applications. I find this very frustrating, but the technology for this integration is not simple. Now that we have reviewed the role that microcomputer technology should have in the policy planning in higher educational institutions, we need to develop a basic understanding the technical issues involved in fulfilling that role.

The integration of different computer components can be likened to communication between human beings of different cultures speaking different languages. If Yuri Andropov wishes to communicate with Ronald Reagan, he must establish a communications link, his identity must be recognized by Reagan; he must speak to Reagan in a language which Reagan can interpret, and then his thoughts must be structured so such that Reagan can make sense of them. Similarly, for two computers to communicate in a functional way, they must transfer data -- and that data must be readable, arrive at the correct location, remain coherent, and be usable by the application program.

First, let's consider establishing a communications link between our desktop microcomputer and a mainframe computer. Conceptually, this is fairly straightforward. Unfortunately, because of the complexity of data communications technology, the marketing strategies of most mainframe computer vendors who hope to keep customers locked into one product-line, and the entrepreneurial nature of microcomputer companies, the user who hopes to integrate microcomputers with mainframes is often frustrated by the incompatibility of systems. The difficulty of interfacing microcomputers with mainframes is not one of technology, but one of marketing, of priorities and, of slow development.

The frustrated user turns to his computer center management to find microcomputer/mainframe interfaces, and often fails to understand the full complexity of the task being defined. Considerable expertise and time must be devoted to develop a complete communications capability.

In an attempt to provide the framework for developing a standard structure for interfacing various computing systems, the International Standards Organiation (ISO), in 1977, developed the Open System Interconnection (OSI) Reference Model. The term **open system** means that the system will support equipment from many vendors performing a variety of functions. The ISO Reference Model consists of seven functional layers which describe the communications process which must occur for complete integration of computers. Figure I, attached, illustrates the seven functional layers.

The bottom layer, the **Physical Link**, describes the physical connectors and cables necessary to link systems and the electical configurations employed. A widely used standard for microcomputers is RS-232-C, which defines precisely the electrical signals necessary on a 25-pin connector. Unfortunately, despite to efforts of the electronic industries of America, no single standard has emerged. It is indeed frustrating to find that even the simple physical connectors used are often incompatible, and special equipment or rewiring is necessary to interface equipment fully capable of communicating at the higher layers.

The next layer, the **Data-Link Layer**, is somewhat more esoteric. This layer includes those functions necessary to ensure that there is a valid communications link between stations. Carrier signals are monitored for quality and signals are multiplexed, that is, arranged so that multiple signals can be transmitted simultaneously at different frequencies. Devices monitor the transmission line to see if signals are garbled because more than one signal at the same frequency is transmitted at the same time, and signal errors are detected.

The third layer, the **Network Layer**, defines the logical path a transmission will follow in proceeding from one station to another. This may be trivial -- if there is a single phone-line from your desktop computer to the mainframe — or it may be complex if there is complicated, sophisticated cabling so that any station may contact any other station, with alternative routings for backup or for high-speed versus low-speed transmission.

The fourth layer, the **Transport Layer**, establishes data communications connections, adds data to identify the logical location of the sending and receiving stations within the context of the network, provides error detection for data transmitted over the network, and handles all house-keeping associated with actually setting up the specific communications-link to be used for the specific task at hand.

Once these four layers have been defined for a given application, the two stations can be said to have established communications. Signals, presumably holding usable data, can now be sent from one station to another. The last three layers ensure that the data is usable. Generally speaking, the lower four levels are made up of systems typically purchased from hardware vendors, although software is a vital part of their operation. Users typically look to software vendors and programmers to solve the problems of the upper three layers.

The **Session Layer** actually orchestrates the functional communications between the two stations. It defines the process by which one station sends out a quantity of information and then pauses to await a special acknowledgement signal. On the receiving end, it defines the mechanism by which the receiving station recognizes the end of a transmission and sends out the acknowledgement signal. It ensures that the receiving station is "paying attention" when the sending station sends. In early radio communications, operators would indicate they had received a message, understood it, and were once again awaiting more imput with the words "Roger; Over". That is the function of the Session Layer.

The **Presentation Layer** often presents the most complex problems for the user hoping to interface different types of computing systems. It is in this layer that the data must be translated into data which are meaningful for the receiving application. Thus, ASCII data from a microcomputer might have to be translated in to EBCDIC for an IBM mainframe. And special characters used for formatting texts must be reinterpretated if the text is to come out on another system as it was originally produced. If this layer is absent, the entire communications process is pointless since the receiving system cannot use the data from the originating station.

The highest layer, the **Application Layer**, defines how the communicated data actually is employed within the application Where successful communication between systems occurs today, it is often through the relatively simplistic process of file transfer. Thus, the application layer is made trivial since the communication of data is essentially independent of the process for which the user wants the data. I can "download" data from the mainframe database to be used in my VisiCalc modelling, but the download process is not run within the context of VisiCalc. Instead, I first download the data, using appropriate communications software, and then I use VisiCalc to process the data already downloaded.

Of course, if the Presentation Layer has not been properly implemented, the data downloaded from the mainframe may not be in proper format to be accessible to the VisiCalc model I wish to employ. Thus the ASCII data on the mainframe may have to be "translated" into the DIF format required for VisiCalc.

Table 2 presents a view of these seven layers in terms of a hypothetical conversation, over the Hot-Line, between Premier Yuri Andropov and President Ronald Reagan.

There are a number of common ways in which microcomputers today are being used within mainframe computing environments. The most common is the simple application of the micro as a "dumb" terminal -- that is, as a terminal communicating with the mainframe emulating the mainframe vendor's own terminals. No data are stored in the microcomputer, and no microcomputer application can be used in conjunction with this mainframe session.

We might note that, typically, the creation of an effective communications link with the mainframe for line-oriented activities (typical of interactive time-sharing systems) is usually reasonably easy. Despite the proliferation of vendors, there are a relatively small number of variations involved, and common communications packages available for most microcomputers will allow communications with most common mainframes. Most online administrative applications, however, require screen-oriented formats. It is considerably more difficult to create an effective communications link with a mainframe using screen-oriented formats. This is not caused by any greater technical difficulty but because the proliferation of different formats, mechanisms, and protocols has led vendors to concentrate their efforts on the few widespread systems and ignore the less common systems because they are insufficiently profitable. In general, asynchronous communications can effectively allow microcomputers to perform time-sharing activities, while administrative applications often require synchronous communications. Synchronous communications are more involved, and few microcomputer communications packages support synchronous communications.

A more creative use of the microcomputer within the mainframe network is for file transfer. In this mode, a communications link is established which allows specific files residing on the mainframe to be "downloaded" to the microcomputer, that is, copied into the microcomputer's memory (and, usually, stored on one of its floppy diskettes). Once the file transfer is completed, the data is available for use by microcomputer applications programs. Often, the data must first go through some conversion program which performs the functions of the Presentation Layer. VisiCalc files, for instance, must be in the DIF format (Data Interchange Format), not normally found on mainframes. Thus the mainframe-formatted file must be read, manipulated, and rewritten into the DIF format. Clearly, the user carries the responsibility here for ensuring that the problems of presentation are resolved before the data are available for the Application Layer. And the communications sytem does not concern itself with either presentation or application.

In the future the presentation and application layer functions will be incorporated within the communications system. The user will use the microcomputer to handle all computing activities, and the application program will automatically establish appropriate communications with the mainframe, when necessary, and transfer and reformat data for use within the application program.

This ultimate integration of microcomputers into mainframe computing environments exists today only in a rudimentary form within some office automation systems. In a true distributed processing environment, the local microcomputer would perform those functions it had both the capability and data to perform, and would automatically request of the mainframe necessary data and transfer activities to the mainframe when it required the capabilities of facilities of the larger system. When appropriately implemented, such integration would provide maximum local user control and ensure the most cost effective utilization of computing resources.

Mainframe file formats have been developed for mainframe applications software which operate efficiently in the environment of large databases with very sophisticated access methods. Often, microcomputers cannot even support these sophisticated mechanisms, and cannot therefore read the mainframe data. A number of vendors of mainframe applications packages are currently developing special microcomputer programs which will allow microcomputer applications to use their mainframe-formatted data. This is done usually by developing a special data-conversion program which reformats the data from the mainframe into the format expected by the microcomputer application. Thus, the user will (probably) not have to acquire special microcomputer applications software once s/he has the conversion package. The conversion packages will be marketed as part of the mainframe application, and will be tailored by the vendor for the specific product marketed.

In their most sophisticated form, these conversion packages will be an integral part of the application itself. Thus a microcomputer user will perform some activity which requires access to data on the mainframe, and the application package itself will generate the "query" of the mainframe, accept the data, reformat it into the appropriate structure for the microcomputer application, and give the user the output desired. The seven layers of network architecture will become invisible.

Suggested reading:

Derfler, Frank, Jr. and William Stalling, **A Manager's Guide to Local Area Networks** (Englewood Cliffs, NJ: Prentice-Hall, 1983).

Martin, James, **Telecommunications and the Computer** [second edition] (Englewood Cliffs, NJ: Prentice-Hall, 1976).

Meijer, Anton and Paul Peeters, **Computer Network Architectures** (Rockville, MD: Computer Science Press, 1982).

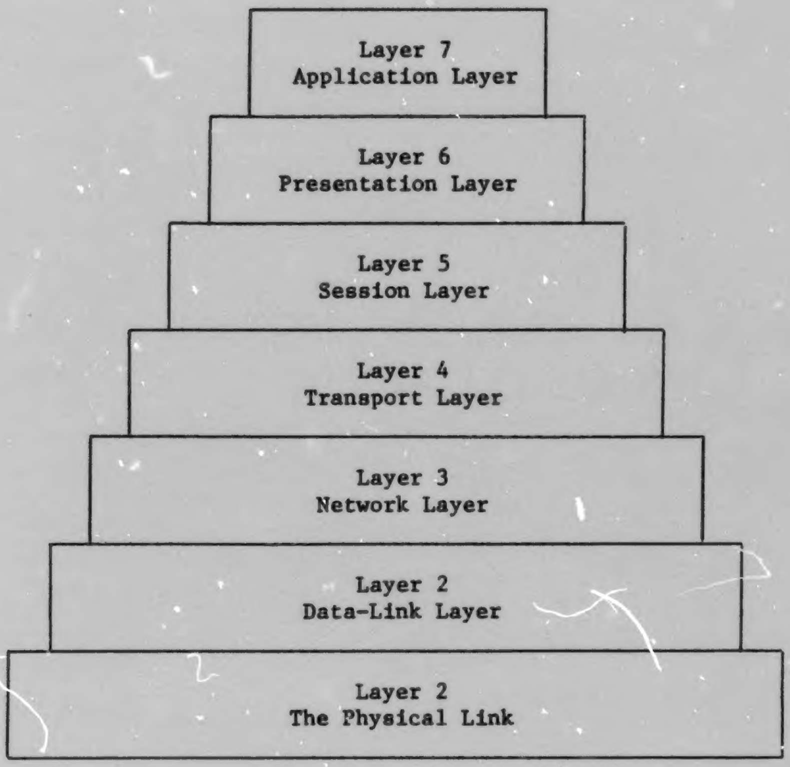
Layer 7
Application Layer
Layer 6
Presentation Layer
Layer 5
Session Layer
Layer 4
Transport Layer
Layer 3
Network Layer
Layer 2
Data-Link Layer
Layer 2
The Physical Link

Figure 1 - The Seven Layers of the Open System Interconnection Reference Model

DIRECTION '88 - TRENDS IN FOUNDATION TECHNOLOGIES

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ABSTRACT

This paper reviews hardware and software trends, and discusses their impact on future data base and data communication systems. The introduction describes how these changes will affect organization structures and how data processing management should respond. The majority of the paper describes the complexity of multi-vendor environments and the emerging standards that are needed to deal with the situation.

In the early days of commercial data processing, it was expected that the computer would solve all business problems in short order. The MIS or DP department was looked to as a white-knight that would slay the "paperwork dragon". When we reflect on those days it is easy to see that the computer has helped, but it has taken much longer than expected. The first systems were rudimentary batch systems which underwent constant maintenance. The data processing department worked feverishly to expand its services, while at the same time, tried to keep its own boat afloat. The combination of constant maintenance to hardware and operating systems along with increasing end-user requests for more reports and new applications has created long back-logs for most companies.

The recent advances in fourth generation languages, combined with better management and larger budgets, has stabilized the situation. By using on-line transactions and ad-hoc query systems, end-users can now get limited access to the data that was taken away 20 years ago. However, many users have not understood the delays, have become frustrated, and started going around data processing. At first, this was accomplished by contracting with outside timesharing services, and more recently by using stand alone personal computers. In most cases, these acts of desperation by end-users are not coordinated with data processing, and cause conflicts throughout the organization. This is unfortunate because further progress is halted as various groups begin fighting for control of data processing resources.

In order to optimize the use of these resources, we must recognize that the end-user and data processing are in the same boat. Each has certain strengths and weaknesses which must be matched in cooperative efforts in order to build the overall company "information utility". It is crucial that companies recognize the importance of this "information asset" because information will become the new source of power. As our economy moves from an industrial to an information based society, data will replace energy and natural resources as the most important company asset.[1]

Data processing currently manages this data asset, and in one sense, is leading the shift to an information based society. Data processing is building the corporate data bases and communication networks which are the necessary infra-structure. Data processing must manage the technology so that the data resources are both more accessable and more secure. At the same time as it manages technology, it must also be aware of the impact on existing organizational structures.

Over the last twenty years, data processing has automated most of the routine company operations. Data processing has become a critical resource, a foundation upon which the rest of the company operates. Yet these functions are mostly what is termed "back-office" operations. They effect the daily routine of the worker, but not the middle or executive management. However, the implementation of a shared data base that is easily accessable through an information network will drastically alter the reporting and authority structure of organizations. It will reduce the number of levels in organizations and alter, or eliminate, the functions of many middle managers and staff personnel. Data processing will be instrumental in helping organizations adapt to these changes. Data processing must make systems easy to learn and it must accept the responsibility of educating people on their use.

In its new role, data processing will produce actual products or services that are delivered to customers and generate revenue to the company. The role will not be just one of staff support, but one of line management. Data processing will begin to reach out from its "back-office" location to permeate the entire organization. The traditional data bases and mainframe processes will be distributed throughout the organization. More batch processes will go on-line and the data networks will be connected to voice networks in order to reduce communication costs. The multiple communication mediums of twisted pair copper wire, fiber optics, satellite, and microwave will be managed by specialized processors in a network control center (see Figure 1).

Much of the basic technology is available today, and some organizatons are trying to apply it to their needs. However, there are a number of problems. Often the various tools are not integrated so that they can be used effectively. They are not structured properly to address the new areas of network management, word processing, office automation, etc. Also, most organizations are struggling to adapt existing applications to utilize the lower cost, higher performance systems. For example, it is predicted that the cost of a five MIP processor will drop from two million dollars today to $360,000 dollars by 1990. In the same time, the cost of one megabyte of memory will drop from $10,000 to $160.[2] Existing applications are often designed to minimize these resources and will not make effective use of them unless redesigned.

Another example shows that communications costs are predicted to rise by 10-15 percent annually over the next few years while the processor costs will fall by 20-30 percent.[3] This means we must place data and processing power at the location of the primary user. Furthermore, these locations are constantly changing as companies grow, merge, or reorganize. Often companies will keep strategic data at corporate headquarters, but distribute the tactical data to the division or department level. Now that personal computers are available, some department data is further distributed to individuals at a local level.

The new systems must allow for this movement of data and processing logic between various machines located at all levels in the organization. The flexibility will allow data processing to minimize costs and achieve the high level of responsiveness demanded by todays dynamic organizations.

Unfortunately, vendors have not built their systems to accommodate this level of flexibility. For example, IBM has multiple incompatible processor lines that are only loosely related through low-level, terminal-like communication protocols. The exception is the 3000 series processors and the 4300 series processors. It is possible to move data and programs between these processors, but only if similar operating systems, data base, and teleprocessing monitors are used. Recently, IBM announced its new PC/370 which is compatible, but the other PC models can only act as terminals to the mainframes. Furthermore, the Series/1 and Systems 34/36/38 are all incompatible.

Even within IBM's compatible mainframes, it is difficult to upgrade from one operating system to another. IBM currently supports three major operating systems. DOS/VSE is the most widely used. It is on about 48 percent of all mainframes. MVS and VM are each used about 22 percent of the time.[4] IBM has introduced MVS/XA to replace MVS, and it is estimated by Yankee Group to take about 32 man-months to upgrade from MVS to MVS/XA. MVS/XA also requires the new 308X series or 4361 mainframe. For these reasons, the migration to XA is projected to stretch out until the late 1980's. While IBM will improve all of its operating systems, and make it somewhat easier to convert from one to the other, it does not appear that IBM will introduce a new operating system to replace these three until 1990 or later. Therefore the compatability and communication problems will remain the user's problem.

The compatibility problems become more acute as companies move to distributed systems because these are invariably multi-vendor environments. This means not only different processors and operating systems, but also different communication protocols. In addition to the public packet switched protocals, there are the various proprietary systems like SNA, DEC-NET and WANG-NET. There are also the various local area networks like Ethernet, Arcnet, and the yet to be announced IBM token-passing-ring. Eventually, these networks will be connected by protocol converting computers called gateways.

Adding micros to the network further increases the variety. There are numerous vendors supplying clerical and professional work stations. Each has their own internal program design and file formats, but many offer support for one or more of the communications protocols. Thus, there will be mixed mode networks that have mainframes, mini's and micros that can at least communicate at the basic message level. This will lead users to expect the full transfer of programs and data between these machines. But it is not that simple. The transfer of basic messages is all that is currently supported. There is little or no common logic at either end to interpret the meaning of the messages. The Open System Interconnection Model defined by the International Standards Organization offers a framework for explaining the problem.

While each vendor's implementation varies, the model is still useful to explain the concepts and foster improved interconnectability. The best known example is IBM's System Network Architecture (SNA). Within the IBM world, approximately one third of all general purpose machines and two thirds of the large 30XX machines use SNA.[4] IBM implements the lower and middle layers of SNA with a combination of hardware, firmware and access method software.

At the lower levels, there are several standards that are fairly widely supported, e.g. RS-232, X.25, etc. At the middle layers, it appears IBM's VTAM and SDLC protocol is becoming one of the defacto standards. WANG and DEC also have their standards, but these each have the ability to interchange messages with IBM. Most of the minicomputer vendors support their own protocols, the X.25 protocol, and many are also supporting IBM's SNA. A survey of non-IBM minicomputer users showed that by 1986, 70 percent expect to use SNA for communications.[5] An example of such a network is the Australian Social Security System which will use SNA protocols to connect thousands of WANG systems, to Amdahl and Storage Technology equipment. There will be no IBM machines anywhere in the system.

At the top levels, there are no standards. IBM has a series of operating systems and program products like IMS, CICS, JES, etc, but it is very difficult to communicate between data base systems or application programs of different vendor. Over the next ten years, these top two layers will become more refined (see figure 2). This refinement will be gradual, but steady. Already the presentation and application layers have been sub-divided into foundation, facilitative, and application layers. IDC, in its recent packaged software report,[6] calls these categories utilities application tools and application solutions. Further refinement includes the relational DBMS, separate network control, active directory control, query, and fourth generation application development tools. User written application logic is shrinking as the new tools provide much of the functionality that previously had to be put in each application program. The newer application packages also take advantage of the better development tools to provide better features and more flexibility.

Word processing is one of the newer areas that needs to be simplified for easier exchange of document is word processing. There is no strong international standard, but there is some effort in the US government to set a standard. There are also some proprietary implementations that are emerging as defacto standards. WANG has recently made the details of their system available at a nominal fee. The WANG Information Transfer Architecture (WITA) will be one of the document formats supported by AT&T Information Systems. In addition to their own, WANG has also committed to support IBM's Document Interchange Architecture and Document Content Architecture (DIA/DCA). This architecture is built on top of SNA and is implemented in the Distributed Office Support Services (DISOSS). DISOSS is an electronic mail and document distribution, storage system. It is implemented on various IBM machines and will gradually be used to interchange documents between all IBM word processing products. Given IBM's size, DIA/DCA is likely to become as important as SNA in future years.

Another area that will be more important in the future are the specific industry standards. This will foster greater electronic communication between companies in the same vertical industries. Standards are occuring faster in banking, stocks, insurance and other industries where the major product is already based on information. But other industries are also building networks which span companies. For example, the airline reservation systems that are used by all airlines have become of strategic importance to the operation of the airline systems and to the profitability of the individual carriers.

These examples show how an internal data processing support systems can grow into a strategic revenue producing systems. In these situations, DP management must change from their budget-oriented, staff-support perspective to one of line management. They must be motivated by profit and return on investment, as well as service and cost reduction.

These industry wide systems also dramatically reduce the lag time between making a decision and seeing the results. For example, using traditional order procedures it can take a month or more to mail an order, recieve shipment, be billed and finally to pay. These times assume normal processing by each company and mail as the method of communication. This can be reduced to a day if all the companies communicate electronically. It can be further reduced to hours or minutes if all processing and approvals are handled electronically. By speeding up the basic business cycle, many other social events are also effected. Naisbitt refers to this as reducing the "information-float" [1]

When this faster pace of business is combined with the growing dependence of business on data processing, it means DP systems must become more flexible and more reliable. These systems must respond in a timely manner or companies will not remain competitive. If they often fail or require constant off-line maintenance, then they are not available for normal business operation.

Most installations now recognize the need to put such layered architectures in place, and most vendors claim to offer a set of integrated tools to satisfy these needs. Thus, users must critically evaluate the quality of each offering, and consider both compatibility with previous systems as well as growth into new areas.

Most of the new decision support and application development tools have been developed in isolation, and do not interface with first generation DB/DC systems. There is a gap between the operational systems developed over the last twenty years and the new tactical/strategic systems we are attempting to build today. This gap forces redundant effort in order to transfer data and maintain consistency between different systems. In some cases, the systems are the same type at different locations, and in other cases, they are at the same location but of different types. In both situations, there is a requirement to extend these systems to communicate more completely and more flexibly to support the new business environments.

The new communication standards mentioned earlier must be improved to offer full networks administration, and application programs must be isolated from details of communication protocols. The relational systems must isolate applications from the location and structure of the data. These systems will include an in-line directory to control the system software during execution. In the future, the directory will be extended with more information about the business enterprise. The new "encyclopedia" or "conceptual schemas" will eventually control the fourth generation application development systems (see Figure 3). It is the goal of Cincom Systems to supply these tools and close the gap between the new application development tools and the Structured DB/DC systems. The plan includes extending the strucutred DBMS to include a relational view processor, and adding network control features to the standard TP monitor.

THE AUTOMATED COMPANY

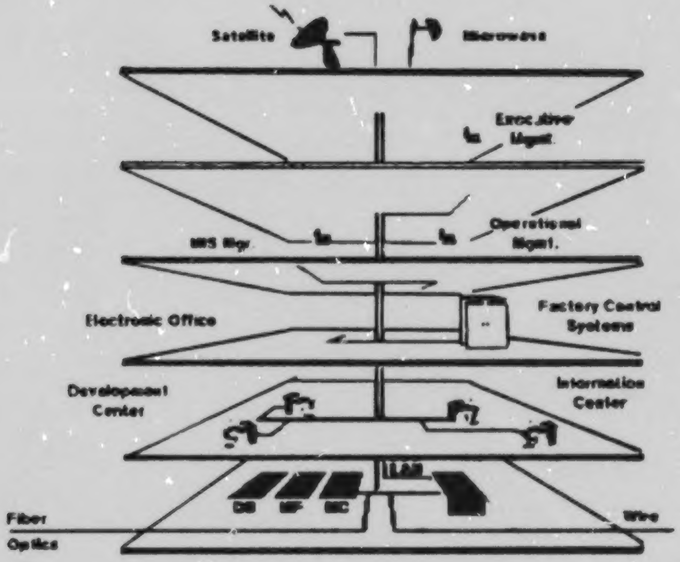
Satellite
Microwave
Executive Mgmt.
MIS Mgr.
Operational Mgmt.
Electronic Office
Factory Control Systems
Development Center
Information Center
LAN
DB
MF
NC
Fiber Optics
Wire

FIGURE 1

(7)

Legend:

DB = Data Base
MF = Mainframe
NC = Network Control
PBX = Private Branch Exchange
LAN = Local Area Network

FURTHER REFINEMENTS OF LAYERED ARCHITECTURES

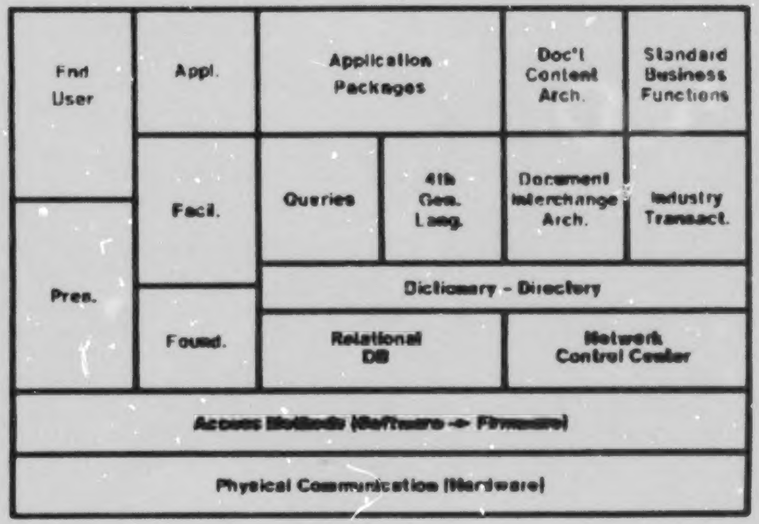
End User
Appl.
Application Packages
Doc't Content Arch.
Standard Business Functions
Pres.
Facil.
Queries
4th Gen. Lang.
Document Interchange Arch.
Industry Transact.
Dictionary - Directory
Found.
Relational DB
Network Control Center
Access Methods (Software -> Firmware)
Physical Communication (Hardware)

FIGURE 2

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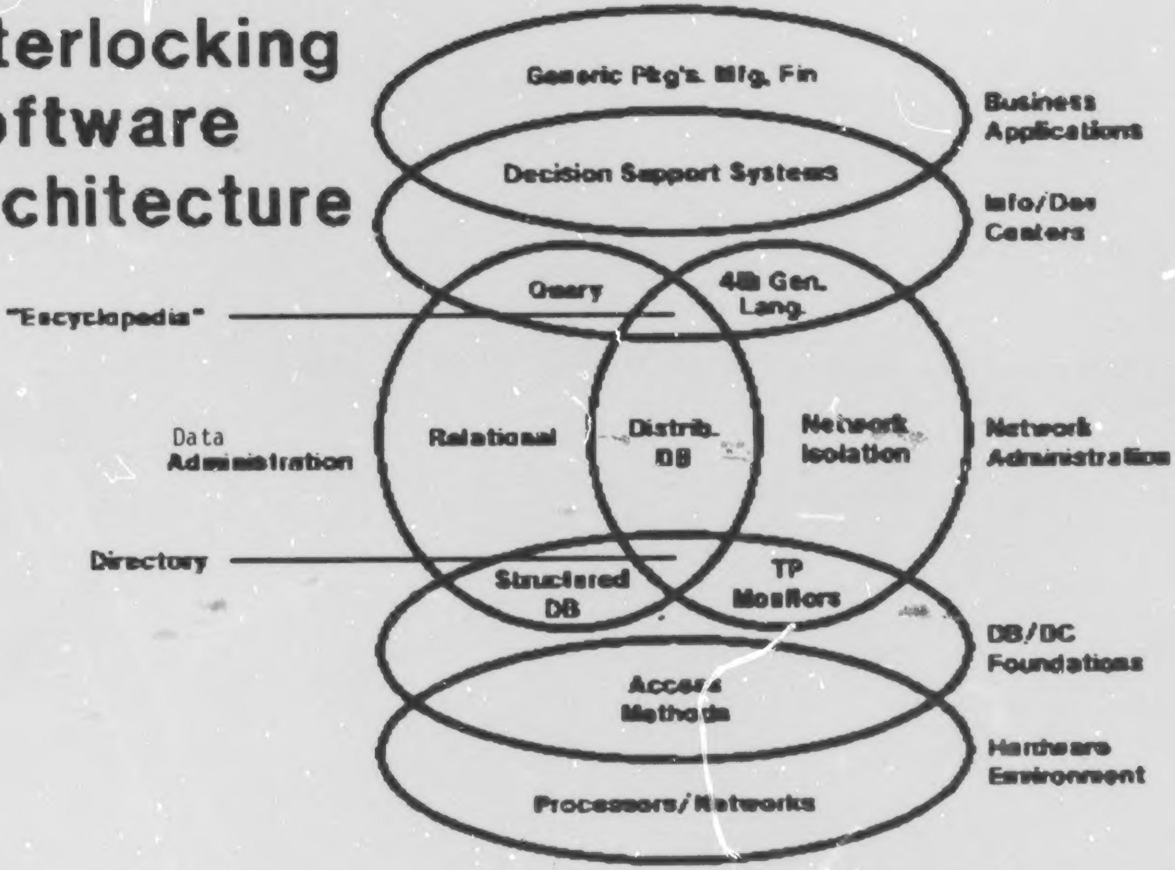
FIGURE 3

Interlocking Software Architecture



Generic Pkg's. Mfg. Fin

Business Applications

Decision Support Systems

Info/Dev Centers

Query

4th Gen. Lang.

"Encyclopedia"

Data Administration

Relational

Distrib. DB

Network Isolation

Network Administration

Directory

Structured DB

TP Monitors

DB/DC Foundations

Access Methods

Hardware Environment

Processors/Networks

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PRIME NETWORKING AT THE UNIVERSITY OF ARIZONA

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Networking at the University of Arizona has progressed through many stages beginning with one PRIME 550 and growing into the current configuration of two PRIME 550's, a 750, an 850, and two 9950's on order.

This paper will cover the evolution of the network, some of the problems encountered and the solutions utilized to solve these problems.

PRIME NETWORKING AT THE UNIVERSITY OF ARIZONA

Working on the premise that the University's administration could better survive with up-to-the-minute information, the Administrative Data Processing Department (ADP), of the University of Arizona undertook a review in 1980 of the alternatives available in computer hardware systems. This review included systems currently installed at the University as well as outside vendor hardware. The systems in use at that time included a Control Data Corporation (CDC) CYBER, and several Digital Equipment Corporation (DEC) systems. These systems were shared for administrative and academic purposes and while the DEC Systems offered some interactive processing, the resources were already saturated and did not provide for sufficient interactive computer support to meet the anticipated administrative demands. While the total administrative computing requirement was still undefined, it was recognized that a solution was necessary which would take advantage of the latest technology, allow the greatest amount of flexibility to accommodate newly defined users and applications, and permit redesign/programming of "old" systems in order to utilize the advanced techniques available. Several sessions were held with computer vendors to learn what kinds of systems were available to satisfy the University's projected needs.

The resulting proposal was to install a network of systems commonly referred to as "super" minicomputers, to be dedicated solely to administrative computing. Superminis are extremely powerful computers and rival the capabilities of the mainframe systems of only a few years ago. With the supermini, The University of Arizona obtained a system that was relatively low in initial cost, required a minimum of personnel support, allowed for modular growth and provided high speed communication between processors. The superminis are designed to accommodate on-line, interactive applications and support a variety of software packages to aid in the rapid development of systems.

The networking capabilities of the superminis allow them to be defined as "nodes" and linked in a distributed processing fashion. Distributed processing allows direct control of user hardware. A network allows the systems to be linked through telecommunications and thus access data from one node to another as may be desired. The creation of a unified shared administrative data bank is possible while maintaining the advantages of distributing the workload over multiple systems. One of the big advantages of the supermini network concept is the ability to retain large data files for instantaneous retrieval.

After an extensive evaluation of minicomputer systems, PRIME Computer Corporation was chosen as the University of Arizona's hardware vendor.

A similar evaluation to identify software development tools resulted in the purchase of TRANSACT, a full screen block mode system generator to interface to the COBOL applications to be designed.

The first of the minicomputers, a PRIME 550, was obtained to support the Undergraduate Admissions system. The development of a system for Police Citations was initiated prior to its delivery by timesharing at a local engineering firm. This allowed some initial training and familiarization on a small system for the development staff.

At the time of the first installation the University of Arizona's approach was to decentralize hardware systems by locating the computers in user areas or in close proximity. In this way user departments would budget for their own hardware and fund the construction of a room in which to house the hardware. Using this concept, the first computer was installed in the Administration Building, two blocks from ADP.

Administrative Data Processing, prior to this time, was primarily a software development group. The network concept presented some unique challenges for ADP as a service organization in the areas of site planning and preparation, security, data base administration, facilities management consulting services, training, documentation and resource planning. User groups were established as a forum for communication between ADP and the user community.

Installation of the first PRIME Computer, the formation of user groups and the anticipation of additional machines sparked a dramatic interest in bringing the University into the state-of-the-art/interactive/real-time world. Soon, a Purchasing vendor system was developed and installed, followed shortly thereafter by a personnel/payroll/ budgeting system.

Development of new systems however, was complicated by the interfaces required to other production systems that were running on the DEC and CYBER computers. The only interface was magnetic tape, but with the decentralization of the PRIME computer, this interface became cumbersome due to the physical distance between computers and the differences in the DEC, CYBER and PRIME system protocols.

By this time there were four production systems on the first PRIME 550. These were 1) Police Citations 2) Undergraduate Admissions 3) Purchasing Vendor system and 4) Payroll/Personnel/Budgeting system. All new development was also located on the 550. The 550 served approximately 40 terminals with 2 MB of memory, and user response time was suffering. This was due, in part, to the mix of production and development activities. Because of increasing user needs for processing capability, two additional systems were purchased. As with the first system, the additional computers were installed in decentralized user areas physically remote from ADP.

A PRIME 750 was purchased by the Student Services department to support systems for Student Health, Student Housing, and Financial Aids development. Another PRIME 550 was purchased by the Alumni Development Office and Athletic Department. Soon after arriving, the Student Services PRIME 750 was running a Student Health system with over 30 terminals on-line. The Student Housing system was under development with 8 terminals for programming and testing by the development group. The Alumni system 550 was running with over 20 terminals in operation.

Various problems with system overloading soon began to develop. These fell into three general categories:

1) Technical Support
2) Operations Support
3) Proprietary Rights

During the first 6-12 months of operation it became apparent that a technical support group was needed to address several issues with which ADP had no previous experience. These included systems software support, third party software support, systems administration, telecommunications and facilities planning. This group was created through reallocation of personnel within the department.

It also became apparent within a short period of time that at least limited operator support was required for the mini-computer. Two major problems were occurring. First, all major files on the PRIMES needed to be backed up at least once a day and, second, when large reports were printed, it was necessary for someone to monitor printer operations.

Since it was not possible to fund new operator positions, it again became necessary to absorb these functions within the department as had been done in providing technical support. Moreover, as systems became more sophisticated and the PRIME computers more saturated, operator support was necessary to respond when various systems were in contention for available resources.

Finally, because the initial PRIME hardware and systems development had been funded by the user departments, users felt they had proprietary rights to dictate use of their hardware. Sometimes to the chagrin of the primary users, it was necessary to allocate resources (based on University wide needs) which resulted in transfer of applications between computers. Throughout this, primary users were considered and resources maintained to process immediate and projected user needs. With the acquisition of more hardware and communication with users, these situations have been resolved satisfactorily. All future hardware purchases are planned for the ADP installation to avoid these problems.

The current configuration at the University of Arizona includes four PRIME super minicomputers and two 2250 "Rabbit" systems. Due to the location of the computers, it is necessary to handle both local and remote system linkages. Since two of the machines are now located in the same room in ADP, they utilize PRIME's local area RINGNET via the PRIMENET Node Controllers (PNC). One of the remote site machines is connected via the Multiple Data Link Controller (MDLC). The University is planning for the acquisition of two PRIME 9950 computers. These will also be located in ADP and be linked to the network via PRIMENET Node Controllers. Future plans include the creation of a data base to encompass all data on PRIME systems. A data base administrator has been appointed to begin the planning, implementation and control of all data. The PRIME INFORMATION data base system has been purchased for use within the organization. Because of the current interface problems between INFORMATION and the current data structure, it is possible that all current production systems will need to be converted in the future. At the present time development is underway to create a complete comprehensive student data base under INFORMATION. The data base will be comprised of data from numerous files and give the University Administration ad-hoc reporting and query capabilities thus far not possible.

Progress to date at the University of Arizona Administrative Data Processing department has been significant. In lieu of having a large mainframe, ADP has used minicomputer "building blocks" to arrive at an affordable highly sophisticated network. This network can handle numerous large on-line systems while retaining the flexibility of adding additional systems to the network and of sharing data in a controlled, planned manner. The minicomputer network will continue to expand as application development and implementation proceeds. Micro-computers and smart terminals will be installed in local and centralized areas of departments. Large minicomputers located in ADP will house databases that will be created from the database subsets currently on the PRIME machines. Database software, query languages, and a variety of easy to use powerful and flexible tools for information access, processing, retrieval, and display will be made available to the University. ADP, through its network approach, will be well on the way to meeting its goals of providing the administrative activities of the University with cost effective and efficient administrative operations, timely and useful data, and appropriate information for planning and management.

TRACK IV
Small College Information Systems

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Peat, Marwick, Mitchell & Co.

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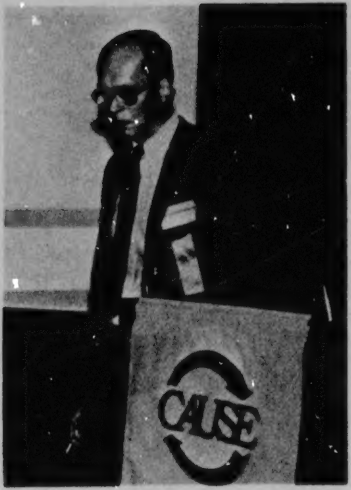
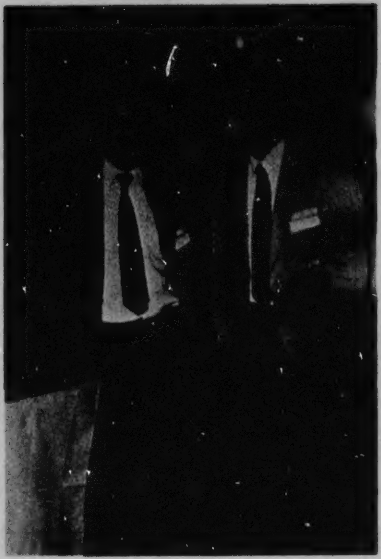


Paul D. Fitt
St. John's University



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Electronic Gamesmanship:
Pitfalls of Implementing on MIS

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ABSTRACT

When Hocking Technical College received a sizable grant for the development of a Management Information System, it seemed that a new day had dawned for organizational information handling. In reality, the implementation of the MIS has proven to be much more complex than anticipated. This paper details the problems encountered in the process and offers solutions which have proven reasonably effective.

Hocking Technical College is a small, two-year institution of post-secondary technical and para-professional training. The rural, Appalachian Ohio college is state-assisted and awards the Associate degree in thirty technologies. Many graduates go directly into jobs while some go on to four year Bachelors' programs. A significant number of students are adults who have spent some time in the workforce and are returning for updating of skills. The college has a combined administrative/instructional computing center based on an H-P 3000, series 3. In addition, approximately 15 micros of various origin have been purchased independently by various college departments for purposes such as CAI, CAT, computer literacy training and instructional development.

The institution has evolved into a dynamic multi-campus facility with an administrator base of 25 individuals—all having their own needs and notions of a Management Information System. Two approaches to software development to meet these needs involve the "quick and dirty" approach or the systems approach. Satisfying information needs through the "quick and dirty" method may be appropriate at times, but developing a system that addresses all the important decision areas of the institution in a coherent fashion is critical.

Hocking Technical College has been with a "System of Sorte" computer system since the day it opened in 1968. Over these 15 years the college has accumulated a mass of ill document software--all being home grown and bastardized each time a new package was purchased. The end result became little more than utility programs to satisfy short term information needs. The goal of our MIS system was to develop or acquire software that will provide information at various levels of the organization. Enrollment information for the Director of Admissions and the President should be from the same data base, but clear and concise for the level of the user.

With the funding of a five year Federal Grant, the notion of an MIS at Hocking Tech seemed more real. Not the least of the motives driving the decision to seek support for the MIS was a dramatic need for an improved fiscal and budget operation. With these things in mind, we explained in our proposal: "The most important problem with the system used for managing information at Hocking Technical College is--there isn't one." Placing the MIS as our first priority in the grant application, we were delighted when the grant was funded, with only minimal cuts in the MIS requested budget.

Reasoning that there was more to know about MIS than we had evidently learned to date, we planned to initiate our development process with the help of a consultant. Since, upon being notified of federal funding, we had been receiving consulting agency brochures by the bagful, we assumed finding such a consultant would be a simple matter. WRONG! We followed a procedure which we feel was particularly useful.

CONSULTANT SELECTION

Along with the RFP which detailed our expectations for consulting services, we required an on-campus presentation by individuals seeking to serve as consultants.

We clearly stipulated in the cover letter the amount of time and money we felt we had for project implementation, based on project funding.

Along with mailing RFPs to all consulting agencies which had contacted us, we called individuals and organizations whom we knew to be knowledgeable in the field. Among the people we contacted were a University president from a major western University, a provost from a major southern University, a senior administrator at a major midwestern University responsible for management information. In addition, we contacted sister technical and community colleges who had successfully implemented MIS projects through grant funding. All contacts mentioned CAUSE as an important starting point. We called the CAUSE office and received helpful general information and several referrals to individuals in the region who had successfully consulted with CAUSE members from our region. We used the same approach with NCHEMS. With those individuals who were specifically mentioned in our phone contacts but not yet on our mailing list, we made direct phone calls inquiring whether they might be interested. As it turned out, the dollar limitations on the first year's consulting were the most important element in a sort of self-screening process. Individuals who seemed very interested by phone were no longer interested when the letter specifying our spending level arrived. Another new fact we learned through this process was that certain consultants who responded wished to represent a particular software package. Because our understanding of our own needs was primitive at best, we felt that the consultant would be most helpful if s/he would offer the broad view of what could be before we began to think about specific software selection.

One of our most important criteria was that the individual we chose be lucid and "non-technical" when dealing with the college management. The ability to communicate the complex to a group of the uninitiated was a prime trait. We knew that to gain not only information about the system, but college-wide acceptance of the system we would have to use the consultant as spokesman as well as informational resource. The on-campus presentation demonstrated two major traits: the willingness to come to the campus indicated interest in the project and a certain commitment; the presentation to a group of administrators demonstrated not only technical competence, but the ability to explain the problem and potential solutions in lay terms. We found that those who actually made the presentation came from among those who had been personally contacted. For that reason, the content of their presentation was relevant and helpful. Indeed, this part of the process was useful in that it established for the administrators present a kind of overview of the needs of the institution which helped pave the way for later adjustments that would be made because of the MIS.

Our final selection of a consultant came down to several key factors: the ability to communicate, a track record which we could check through references among colleges similar to our own, a reasonable proposal, proximity within a reasonable distance to our campus, demonstrated mastery of appropriate concepts, familiarity with the hardware and general approach currently being used on our campus.

EMPLOYING PROFESSIONALS

Seeking qualified programmer/analyst candidates to fill the primary professional position associated with the implementation of the MIS at Hocking Tech may have been the process which taught us our own limitations most effectively. We thought we had covered all the bases when we advertised nationally, regionally, locally and on several major university campuses in our vicinity. As applications began to come in, it became clear that our job description was so broad that we were soliciting three different kinds of candidates: those who were good communicators but had little or no knowledge of our hardware; those who were primarily system engineers who had little experience with user contact and those who were neither but hoped they could "learn on the job." These facts are best illustrated when we report that of the thirty three applications, the committee felt it could select only five for screening interviews. The consultant, independently reviewing application data, came up with three of the same five candidates. The strongest candidates on paper, we found, were also individuals who had had some contact with the college over the years either in instruction or administrative computing. This led us to an interesting conclusion. Individuals responding to our national and regional ads did so in spite of our little known name and location--on spec--so to speak. The individuals who responded locally, were people who had a reason to want to stay in the community or to affiliate with the college itself. From among these people we found a much more attractive group of candidates in terms of credentials, experience and information. In a sense, their "limitation" to the Hocking Valley region brought the most qualified people to us.

One important selection factor was existing computer center staff, notably the Director of Records who was himself a candidate for the position. We reason that the MIS position was attractive to him primarily because it would free him from the confining daily operational concerns and allow him to spend more time doing what he enjoyed doing--developing new programs. The problem with his candidacy was two-fold. First, much of the software which the college had managed to develop over the years was documented primarily in his head. Second, he had, by force of the many demands on his time, been forced to say "No" to many potential users of the system so often that he had lost credibility with those whom we would hope would approach him for assistance. Needless to say this created a certain tension about the selection process which might not occur at other institutions. However, it seems likely that the attendant concern would be quite common--that this individual would feel infringed upon when the new Management Systems Director finally was hired. Thus, it became very important for the successful candidate to be able to cope with the delicacy of the situation and still get the job done. Other criteria we sought in the candidate were: good communicative skills, understanding of the H-P 3000, ability to program in several languages including COBOL and Assembler. Experience with Management Information Systems was of major importance. After at least one prime candidate was enticed away from us by a private sector corporation in another city able to offer twice the salary, educational and other benefits which we have no access to, we regrouped and actively recruited from among the college faculty in computer science. Excluding a number of details of the process, we were finally able to attract the incredibly talented lead instructor of the program who is now with us. Along with enormous competence in all of the characteristics we sought in a candidate, she has the respect and confidence of the Computer Center Director.

PREPARATION FOR NEEDS ANALYSIS

To prepare for the consultant's first visit, we announced to administrative staff an general overview of the process, and asked their cooperation in responding to a brief question: how do you anticipate the Management Information System can be used to serve your needs? Some individuals did not respond at all in writing, but contacted us personally, to explore the range of possibilities open to them. It became clear through both written and oral responses that most of the future "users" of the system were novices at conceptualizing system applications. Some articulated very simple, short and specific programming needs; others sought complete, complex problem solving by computer when they imagined what the system could provide them. This preliminary information gathering was doubly useful: first, it provided a "forum" for all interested parties to express their expectations; second, it gave our consultant (and the principles within the organization) some notion of the general level of naivety which marked potential users of the system when implemented. On his first visit to the college, the consultant met with the college president to get an overview of his expectations of the process, the grant manager and activity director, and major administrators who had already responded to the earlier request. In addition, the consultant spent considerable time with both the Director of Records and the lead instructor of the computer science instructional program.

NEEDS ANALYSIS

The consultant facilitated the needs analysis with a "Plan to Write a Plan." This working document laid out several important steps in developing a long range plan for MIS:

1. A general informational meeting for all interested parties conducted by the Activity Director and Grant Manager.

2. A format by which individuals would submit specific requests for software development, purchase and hardware allocation.

3. A series of individual interviews between Programmer/Analyst and potential system users to clarify and elaborate on system requests.

4. A costing-out of requests to report back to requestors on what personnel, system and institutional resources would be necessary to actually fulfill the need expressed. The consultant offered to help with this.

5. A college committee to prioritize user requests.

6. A "long" range plan based on committee priorities.

To date, the college has completed steps one through three.

ORGANIZATIONAL STRUCTURE

Before the actual hiring of the Director of Management Information Systems, considerable effort went into planning the relationship between the MIS and on-going operational computer center activity. This is a step which we strongly recommend, so that all individuals associated with the process fully understand the reporting structure of the operation. In our case, two important steps were taken. We divided computer service activity into two major functions: college operations/instructional support and management systems development. Both the Director of Computing and Learning Services and the Director of Management Information Systems have system manager status. The one position handles hardware maintenance, on-going project maintenance, and development of projects which seem operational or instructional in nature. The Director of Management Information Systems actively engages managers and administrators in a dialogue regarding the development of the MIS, develops programs and data base in support of the MIS, and is developing the so-called "long range plan" for system services. Together, the two individuals have worked out a plan for screening requests to determine which of them will be involved and are about to develop policy on documentation and user access. All is not sweetness and light, however, for the two have major philosophical differences in such matters as system security and user access. With the administrative structure designed as it is, however, these differences of opinion, too, seem to be working out. A key reason for their willingness to work together to resolve their differences has been the realization that users have "played them off against each other," claiming that the one or the other was not responsive or reliable. At this point, they meet regularly to discuss requests for this reason.

COPING WITH HARDWARE

In our eagerness to obtain MIS development funds we overlooked the impact a broad-based system would place on existing mainframe operations. Indeed, even before project implementation the instructional people had documented a problem with response time. In order to cope, once we understood the limits of the existing plant, we tried to locate a hardware consultant. While our HP vendor was willing to send a diagnostic engineer for $1,000/day, the college president was unwilling to pay that kind of money. Once again, our consultant offered assistance, explaining to us and to our vendor in our behalf that system assessment would lead to some kind of purchase and thus, the vendor would be well-served to pay the assessment fee. And so it was. The outcome was a report which offered three different approaches, the cheapest of which we selected.

SOFTWARE AND VENDORS

After a considerable amount of time and effort in setting goals for our MIS system, a decision was made and approved by the President to implement the financial and budgeting section of the Management Information System. Time was of the essence because funds would expire. An institutional philosophy had always been to "do it yourself" or develop home grown software. Because of problems this had caused, a shift or change of philosophy was necessary. A sophisticated budget system could not be home grown with existing personnel.

Because existing hardware limited vendor availability, an effort was made to become aware of another institution who purchased a system with the same complete system as ours. An on-site visit was made to the other institution and a request for a proposal was solicited from the vendor. The vendor also conducted an on-site demo at our institution. Two other vendors were contacted with one not responding to our invitation and the other not providing an encumbrance element in its system. After several phone recommendations, a decision was made to purchase the system. We learned through this early search that reliance on vendor information about packaged software is dangerous. Vendors, naturally enough, sell their own products. Contacts with similar institutions are much more productive. Requiring a list of customers is first on our list of software requirements.

A LOOK AT THE FUTURE

No amount of tuition in formal educational programs could have provided us with the understanding which this short year and a half has offered with regard to Management Information Systems and their implementation. As we move into a more detailed implementational phase, we expect increased sophistication among our users who, while being helped to make reasonable requests of the system are also learning what is doable, what it costs, and how long it might take, given system demands. The Director of Management Information Systems will begin to conduct user training sessions, as hardware is distributed throughout the college plant. While the MIS has been initiated, the college has also been in the process of constructing an Information Sciences building which will house the computer center and instructional computing as well as a CAI lab and micro labs as well as an "Office of the Future." In order to integrate data, audio and video functions campus-wide, the college will be installing Broad Band cable plant within the next six months. This development will clearly mark an important milestone for the MIS as well as for campus information use sophistication, for it will allow data user installations to interact not only with the mainframe but with each other. Again, in order to make maximum use of the opportunities this development offers, we expect to make use of consultants knowledgeable in the potential and pitfalls of the local area network with regard to MIS.

On the campus there remain those individuals who are skeptical of systematizing management information. These people reason that systematization is tantamount to fossilization, stultifying creativity and limiting the ability of the institution to change. Some are simply fearful of an encroaching technology with which they are unfamiliar and uncertain whether they are capable of learning. Our strategy in coping with these individuals is to "let be," allowing those eager for MIS assistance to lead the way and demonstrate the usefulness of the process. We hope that, if the pace is slow and progress well-publicized we will continue to attract individuals to participate through success. Our Director of Management Information Systems assures me the eager people are enough to keep her busy for the term of the grant. Once a number of administrative areas are working within the system, pressure from their peers as well as their constituents should bring the more reluctant users into the system as well. If it meets our high hopes and expectation the Hocking Tech MIS will be facilitating the planning process at the college by 1987--just a dream when we began to think about applying for federal grant for a Management Information System.

MANAGING RISK IN SYSTEMS DEVELOPMENT

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Implementing major new information systems continues to be a risky venture. This paper presented at CAUSE 83, described a risk assessment methodology that has been developed to better manage the risks associated with systems development projects. The risk assessment methodology was described and illustrated by showing how Stanford University has used it to improve the management of its systems development efforts.

MANAGING RISK IN SYSTEMS DEVELOPMENT

Implementing major, new administrative systems for colleges and universities continues to be a risky venture. Campus officials must address complex systems approaches and design decisions as they attempt to keep pace with technological advances in computing hardware, software and communications. It is no longer unusual for development of these systems projects to exceed $1 million. Failures can jeopardize normal operations such as registration, payroll schedules and sponsored project billings. With unsuccessful projects, scarce financial resources are wasted, jobs can be lost and the credibility for future successes severely damaged.

Traditionally, we have not been very sophisticated in understanding what makes one kind of systems development project less likely to succeed than another. We know intuitively that projects of long duration normally have more problems than shorter term projects. Likewise, projects involving many end users, such as an integrated student information system, are generally more difficult and higher risk than projects involving only one or two users. Many other factors, such as familiarity with the technology, experience of the project management and the impact on user operations, suggest that there may be a variety of interrelated reasons contributing to a project failure.

If a way could be found to identify each of these risk factors and assess their importance for a particular project, we might be able to make management decisions that would change the inherent risk of our development projects and give us a better chance for success.

In the September-October 1981 Harvard Business Review, F. Warren McFarlan published an article, "Portfolio Approach to Information Systems," proposing that major disasters in system development efforts could be averted by assessing the risk of projects, separately and in the aggregate, in advance of implementation. He advocates that the management approach should be designed to fit the level of project and portfolio risk.

Professor McFarlan's article generated a great deal of interest among University management as it described systems development issues that continue to plague the University. Stanford requested Peat Marwick's assistance in expanding on McFarlan's basic concepts to develop a risk assessment process specifically tailored to the University environment.

After the analytic structure was completed in April 1982, Stanford piloted the method prior to institutionalizing the process. This article discusses the University's approach to risk assessment and portfolio* management.

UNDERSTANDING WHAT RISKS ARE

Risk analysis requires an understanding of the basic concepts of hazard, peril and risk as they relate to the system development process.

- A hazard is the specific situation that introduces or increases the probability of occurrence of a loss arising from a peril, or that may influence the extent of a loss. Such situations are slippery floors, inexperienced management or earth faults. In a system development process, hazards are defined as situations from which peril and loss might be anticipated, such as a large number of user departments, inexperience with large system development efforts, or insufficient user involvement in the project.

- A peril is the contingency which may cause a loss, such as an accident, explosion or fire. In a system development process, perils are such contingencies as poor system design, design not meeting user requirements and budget overruns.

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*By a "portfolio" we mean the complete set of systems development projects.

- Risk is the uncertainty as to an event's happening or the extent of consequences if it does happen. For example, the San Andreas fault (hazard) can cause an earthquake (peril) with risk varying depending on such factors as population density and time of day of occurrence. Risk for a university's system development process involves exposure to adverse consequences such as the failure to meet user system requirements, costs that vastly exceed budgets, and completion schedules much longer than anticipated.

By measuring risk, we are not implying that no risks be taken. However, we need to understand risks fully to effectively manage them. Generally, higher risk system development projects must have associated higher benefits. The choice of the best route for development requires an evaluation of the risks involved as to their significance, acceptability, probability, consequences and potential benefits to be realized. Among the factors to be considered are:

- What are the alternatives?
- What are the associated risks of the alternatives?
- What is the risk of not developing a system?

Once the risks have been evaluated, we can take actions that change the level of risk or make the deliberate decision not to intervene.

HOW TO ASSESS RISK

Risk in system development efforts can be assessed from three key elements. These elements are size, structure and technology.

- Size includes such characteristics as the amount of development budget, length of time to develop, staffing levels and number of user departments involved.

- Structure considers the degree to which the users and data processing can define the requirements of the system, the impact on user operations and procedures, the functional and management qualifications of the data processing project team and the administrative and control procedures employed.

- Technology examines the technical experience of the project team, the technological approach, the development environment, and the technical requirements of the system.

Table I illustrates key factors identified for Stanford that reflect the size, structure and technology elements for that institution's systems development process.

The components used to assess risks will vary for each institution depending on the approach taken toward systems development. For example, institutions emphasizing the use of commercially available software and avoiding "home grown" systems will have risk components that are significantly different from those that do primarily in-house development. Institutions that have chosen to use only leading-edge or state-of-the-art technology will have much different risk components than institutions that elect to use proven or old technology.

At Stanford, we closely examined our approach to systems development projects and postulated 63 questions that tied back to the three elements: size, structure and technology. Table II illustrates some of the questions for Stanford.

An overall objective in Stanford's approach to risk assessment is to convert a general unquantified understanding of risk factors into specific, quantifiable terms that can be compared through a project's life cycle, between projects and across organizations. This overall objective led to a set of criteria to be used in determining specific questions and classifications. The criteria used in the questionnaire design are:

Table I

FACTORS THAT AFFECT RISK

- **SIZE**
  - Dollars
  - Time
  - Flexibility in schedule
  - Data processing staffing level
  - User staffing level
  - Ease of staffing
  - Number of user departments

- **TECHNOLOGY**
  - Hardware
  - Software
  - Development tools/techniques
  - Communications approach
  - Use of software packages
  - Technical experience of project team
  - Availability of backup personnel
  - Vendor experience
  - Stability of development environment
  - Data conversion complexity
  - Performance requirements
  - Security requirements
  - Complexity of application interfaces

- **STRUCTURE**
  - Project management
  - User support, attitude and commitment
  - User functional and data processing experience
  - Project leader experience
  - Project team functional knowledge
  - Functional requirements definition and volatility
  - Impact on user operations

Table II

SAMPLE RISK ASSESSMENT QUESTIONS

I. SIZE

D. USER STAFFING LEVEL

1. What is the expected maximum size of the user project team?

   a. 1 to 2
   b. 3 to 5
   c. 6 to 8
   d. More than 8

2. Is the user staffing level (expected staffing level) adequate for the project?

   a. Adequate level of staffing
   b. Slightly understaffed, anticipate minor impact on project schedule
   c. Severely understaffed, will lengthen project schedule

3. What percentage of the user project team can be staffed with existing personnel?

   a. 90% to 100%
   b. 67% to 89%
   c. 34% to 66%
   d. 0% to 33%

4. How difficult will it be to obtain additional permanent staff or contractors due to specialized skill requirements, budget constraints, etc.?

   a. Not difficult
   b. Somewhat difficult
   c. Very difficult

E. NUMBER OF USER DEPARTMENTS

1. How many departments could be described as primary system users in this project?

   a. One
   b. Two
   c. Three
   d. Four or more

2. How many departments are involved as secondary users in this project (e.g., primarily for information purposes)?

   a. None or one
   b. Two
   c. Three or more

II. STRUCTURE

C. DATA PROCESSING TEAM QUALIFICATIONS

1. What is the experience of the data processing project leader with projects of similar type?

   a. Demonstrated performance at Stanford with similar systems
   b. Demonstrated performance at Stanford but with different type systems
   c. Prior experience with similar systems but no Stanford experience
   d. No prior experience

2. What is the experience of the data processing project leader with projects of similar size?.

   a. Demonstrated performance at Stanford with similar systems
   b. Demonstrated performance at Stanford but with different size systems
   c. Prior experience with similar systems but no Stanford experience
   d. No prior experience

III. TECHNOLOGY

C. DEVELOPMENT ENVIRONMENT

1. Will the project team have difficulty in obtaining adequate computer resources and development tools?

   a. No problem anticipated
   b. Limited problem
   c. Serious problem

2. To what extent are changes in development hardware or software anticipated to impede progress on the project?

   a. Limited impact
   b. Moderate impact
   c. Considerable impact

BEST COPY AVAILABLE

- Categories and subcategories represent major areas that influence risk of system development efforts, and a relative weight can be assigned to each classification. This implies that:
  - questions should not attempt to address the totality of project attributes but only be indicators of risk for that classification; and
  - the number of questions in a category or subcategory should be relatively proportional to the weight of that classification.
- Answers must be quantifiable and comparable across projects. This implies that:
  - questions should be concise;
  - no questions can be dependent on responses to other questions;
  - only one answer per question is allowed;
  - all questions must be answered; and
  - answers, therefore, may be subjective, requiring informed judgment.

The questionnaire is used at key points in a project's system development life cycle, such as at initiation, definition of system development approach, and at major project milestones. In addition, it is used to update the portfolio risk profile at specific times during the year, such as prior to the budget cycle. It is intended to be completed by individuals knowledgeable about the project, such as the manager, project leader, analyst and the user. Naturally, responses will differ and will need to be reconciled.

Responses to the questions establish the extent of hazards and perils for each project. Numeric values are assigned to each response and are totaled within each subcategory. These values are converted to percentile values to reflect the relative risk of the project for that subcategory. Each subcategory is weighted to determine percentile values to reflect the relative risk of the project by category and a composite score. Scores are classified as low, medium or high risk levels. Any project can be low in one area and high in another. Thus, overall risk is not a sufficient measure without also looking at the component scores.

ANALYZING THE RISKS

Responses to the questions can be presented in a graphic display that readily shows the relative risks for each project in the portfolio. The accompanying graphs illustrate how disparate risk can be in systems development projects. Figure 1 shows the risk assessment for a new fund-raising system. It is a large project (48 man-months) using a leading-edge technology (DBMS, networked, on-line updating) and has a relatively high risk level. On the other hand, Figure 2 shows a small accounting system project using well-known technology, and its risk level is much lower. In our analysis, we have determined that risk values of 40 and below are relatively low, 40 to 60 medium risk and above 60 relatively high risk.

A useful feature of the risk analysis is the communication that takes place among project team members. We found that perceptions of project risks frequently varied among the project manager, analysts, programmers and users. Often the difference in viewpoints was due to the lack of specific knowledge, such as the technology being used or the strength of the project team.

In the assessment of the accounting maintenance program (Figure 2), the user rated the project as medium risk, but the data processing manager, project leader and programmer all rated the same project as low risk. The difference in scores is dramatic. It is obvious that very little communication was taking place between the user and the data processing project team. While everyone was in general agreement as to the size of the project, they differed on the way the project was structured and on the technical solution proposed. A meeting was obviously needed to discuss these differences. Unfortunately, that meeting never took place. The user did not get what he wanted, and some major reworking was required. Thus, the graphs were telling us something real, but because the project was quite small and because the graphs were not prepared until several months after the data was collected, the problem had long since been dealt with the hard way. In this case, it seems clear from the results that management could have stepped in early in the project life and ironed out the differences which existed.

Risk assessments for individual projects can be consolidated into a portfolio risk assessment for the entire set of systems development projects. Figure 3 is a representation of such a portfolio risk assessment. In this instance, it shows a balanced risk with a clustering at the 60 level which borders between a medium and high risk portfolio.

MANAGEMENT DECISIONS USING RISK ANALYSIS

Managing risk in systems development efforts is the primary objective of the risk assessment process. Management decisions occur at two levels, individual project management and portfolio management.

Project management is improved through the risk assessment process if the assessment is made at key points in the project's life cycle. These key points include:

- Prior to Initiation. An assessment of risk at this stage defines the risk level management is willing to assume. There should be a correlation between risk and benefit, i.e., the higher the risk the higher the benefits.

- Start of Project. At the start of the project, the budget has been defined, staff identified and most likely the technological approach is known.

FIGURE 1

PORTFOLIO RISK ASSESSMENT
FUND-RAISING SYSTEM

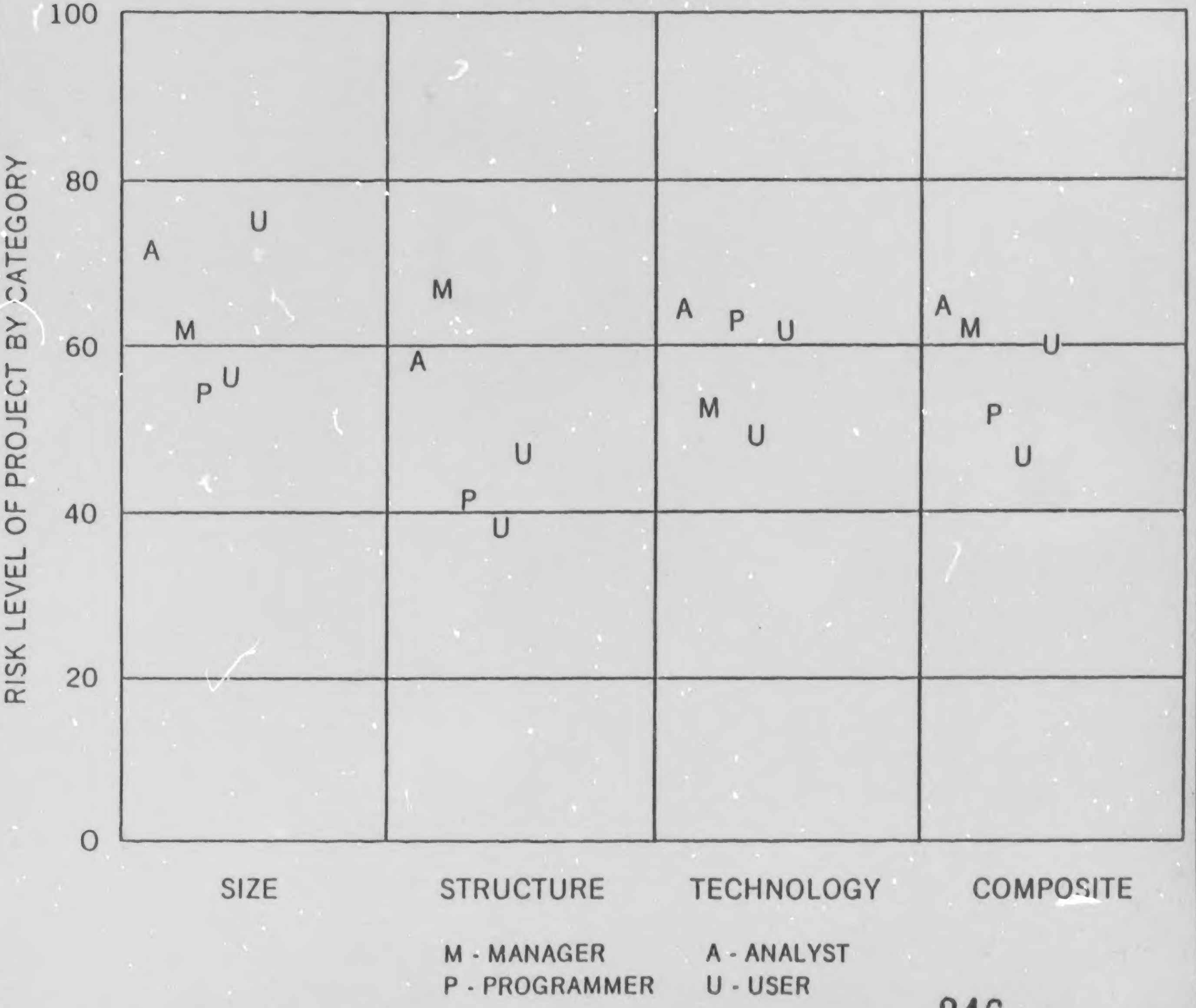


FIGURE 2

PORTFOLIO RISK ASSESSMENT
ACCOUNTING MAINTENANCE PROGRAM

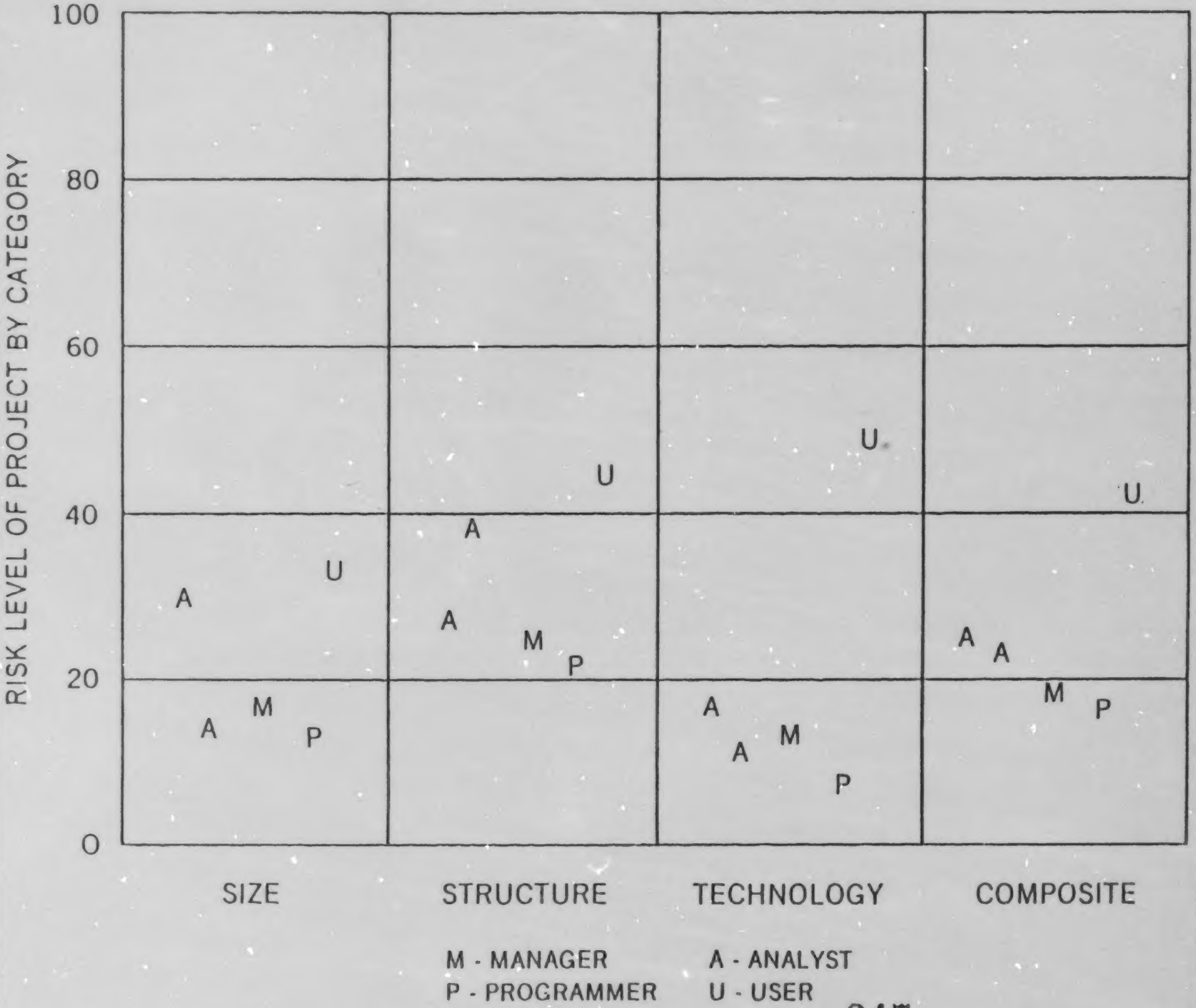
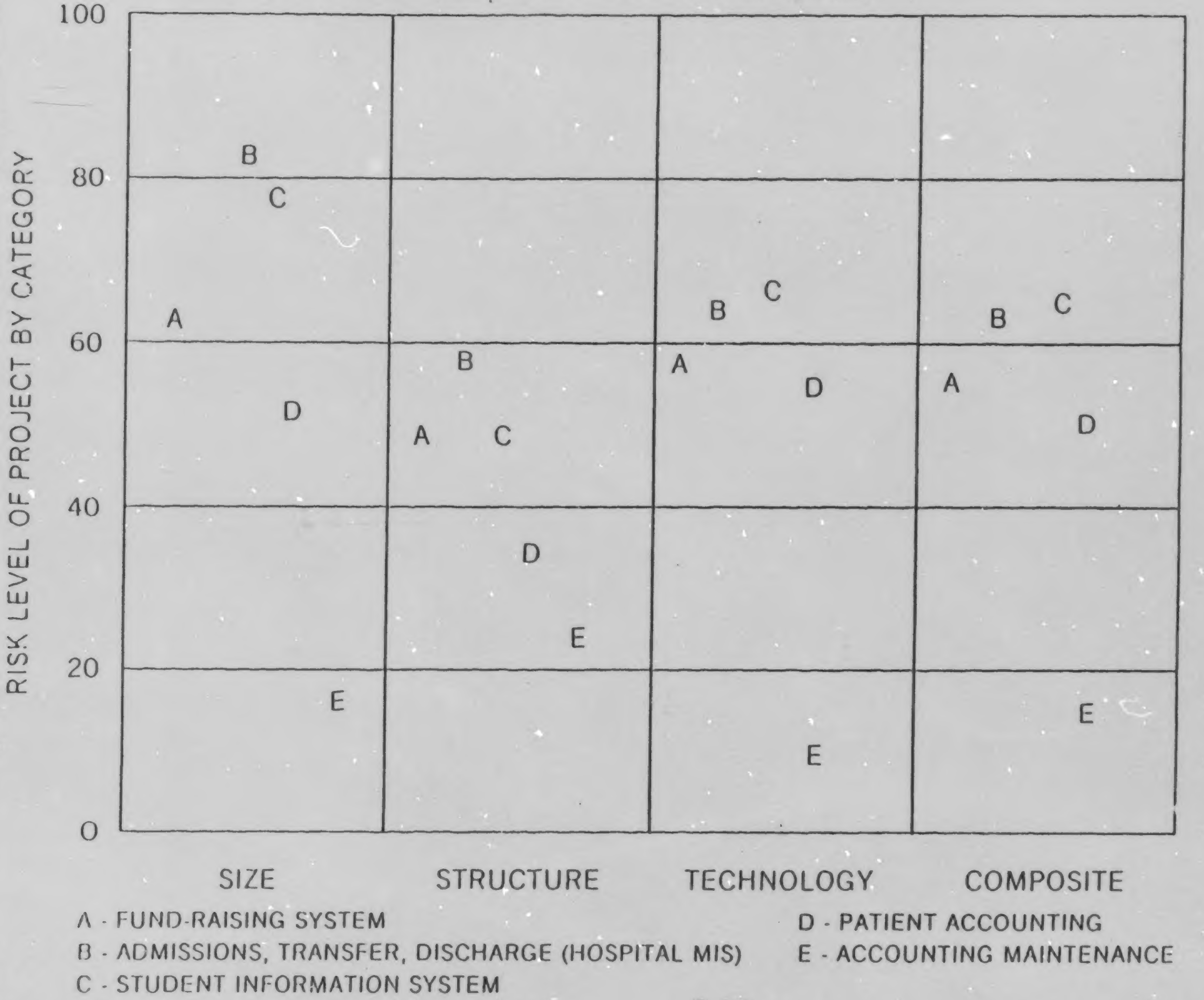


FIGURE 3

SYSTEM PORTFOLIO ANALYSIS



- Key Project Milestones. At each milestone, a risk assessment will reflect if the project continues to be well managed and under control. Delays in schedule, cost overruns and technology problems will be reflected in the assessment and increase the risk level.

- Completion of Project. A final risk assessment is necessary to complete the cycle and as part of the post-implementation review. Examination of the risk assessment trend for each completed project provides excellent comparisons for future system development efforts.

If a project's risk level varies from what we predetermine is appropriate, there are several actions that can be taken. Table III illustrates some of the actions that can be taken. Projects that have risks considered too high can be reconfigured and risks lowered. Likewise, projects that may have too low a risk level can be modified generally freeing up resources that can be used on higher risk projects.

Management of the portfolio can also be improved through the risk assessment process. An institution should predefine an acceptable risk level for its system development projects. The predefined risk level is dependent on the importance of data processing to that institution's academic mission, goals and program. For example, at Stanford it is important that administrative systems take best advantage of state-of-the-art technology and, when necessary to accomplish management objectives, use leading-edge technologies. Emphasis is placed on producing high quality management-oriented information necessary to support Stanford's aggressive and dynamic instruction and research program. Because of these information system and technology demands, Stanford is willing to accept a higher risk portfolio position than if it were not in such a complex and aggressive operating environment.

Table III

MANAGEMENT OBJECTIVES MATRIX
DEPENDENT ON RISK LEVEL BY RISK ASSESSMENT CATEGORY

RISK ASSESSMENT CATEGORY / RISK LEVEL	SIZE	STRUCTURE	TECHNOLOGY
HIGH	• Break up project into sub-projects • Implement formal SDLC • Establish frequent project milestones • Establish formal project tracking & control system • Establish formal communication channels	• Increase user involvement • Implement formal SDLC • Redefine project objectives • Establish formal sign-off on user requirements • Increase training for users & data processing • Use more experienced staff or seek outside expertise	• Increase technical training for data processing • Hire in or contract for required technical skills • Examine package software alternatives • Use more familiar technology
↕	↕	↕	↕
LOW	• Use single phased approach • Implement simpler version of SDLC • Establish fewer milestones • Implement simpler version of project tracking & control system	• Opportunity to use less experienced management or staff on the project • Examine structure characteristics compared to other projects in portfolio	• Re-examine technological approach compared to other projects in portfolio • Opportunity to use staff with less technical expertise

With a predefined risk posture, an institution then has a benchmark to compare with the measured risk. Actual risk levels below the targeted level may indicate that expected benefits are not being programmed or that projects are overfunded, overstaffed or using outdated technologies. On the other hand, a risk level that exceeds the target may reflect overly ambitious goals, use of unfamiliar technologies or lack of staff and funding.

CONCLUSION

The risk assessment process adds a new and necessary ingredient to data processing management. As technologies advance and skilled professionals continue in short supply, we sit on the razor edge of success or failure in our system development efforts. With the ability to continually measure the level of risk of our development projects, we can better anticipate problems and make decisions that will forestall failures and create successes.

RELIABLE RECORD MATCHING FOR A COLLEGE ADMISSIONS SYSTEM

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This paper describes a successful technique that allows prospective student data, supplied by the various national college testing and student search services, to be matched with existing student records in a college admissions database. Instead of relying on one unique record identifier, such as a social security number which may not always be available for every student, a technique has been developed that is based on a number of commonly occurring data elements, which provides a link between the external data source, and the existing student record. The matching technique has proven to be highly reliable, has minimized record duplication, has reduced clerical efforts in record maintenance, and can be used with data from a variety of sources.

Applicant based admissions systems can be characterized by the following qualities:

A) The admissions process was initiated by the student. The completed application form was the originating document that caused the student's record to be entered into the admissions system

B) The student's social security number was used as the unique record identifier in the system

C) Fairly complete personal data about the student was received at one time. Less subsequent record updating per student record was needed

D) The number of student records in the admissions system was predictable from year to year.

PROSPECT/INQUIRY BASED ADMISSIONS SYSTEMS

The last several years in higher education have provided college admissions officers with some of their greatest challenges. With declining birth rates and shrinking applicant pools, admissions officers can no longer wait for students to initiate the admissions process, but must actively seek out and recruit prospective students for their institutions. The need to track students from initial contact through final admissions decision, the demands of market analysis, and the desire to do follow-up contacts are not possible with admissions systems that are based on the receipt of a completed application form.

Many institutions of higher education have developed separate prospective student systems to meet the special needs of student recruitment. These systems exist independently of the applicant processing system. Such dual systems are common among larger colleges and universities where the responsibility for student recruitment is delegated to an office other than the admissions office. Although such dual systems may provide each office with the necessary student information each requires, unnecessary record duplication may result unless the systems are highly coordinated.

A totally integrated system, one that allows both prospective student data and applicant data to co-exist on the same file, is an alternative means to managing admissions data. One major drawback to such an integrated system is that the student's social security number cannot serve as the system's unique record identifier, since it is usually not available at the time of initial student contact. It is this record identifier that allows the student's record to be updated with ACT/SAT test results received from the national testing services.

Increased use of prospective student data acquired from participation in the national student search services, SSS and EOS, presents a similar problem for an integrated system. Although participating institutions can specify selection criteria based on test scores, high school grade point averages, etc., the actual data released to the institution is minimal: name, address, high school code and intended field of study. Incorporation of this data into an integrated system, without duplicating existing records, has proved to be a formidable task.

Prospect/Inquiry based systems can be characterized by the following qualities:

A) Any type of student contact can serve to initialize the student's record into the admissions system, including the use of student search data

DEFINITIONS

Throughout this paper a number of terms will be used that may not be familiar to those persons who are not directly involved in the area of college admissions. For the convenience of the reader these terms are defined below:

ACT	-	A national college admissions test sponsored by the American College Testing Program, Iowa City, Iowa.
Applicant	-	A student who submits an application for admission to an institution of higher education. If accepted the student may enroll at the institution, or cancel his/her application.
Educational Opportunity Service (EOS)	-	One of the national prospective student search services sponsored by the American College Testing program.
Inquiry	-	A student who has expressed an interest in a particular college by taking some action of his/her own, e.g., requesting an application form. An inquiry may apply for admission, be accepted and enroll at the institution.
Prospect	-	A potential inquiry. The student's name has usually been obtained through participation in one of the national student search services. The institution of higher education initiates the contact through an informational mailing.
SAT	-	A national college admissions test sponsored by the College Board, New York, New York.
Student Search Service (SSS)	-	One of the national prospective student search services sponsored by the College Board.

APPLICANT BASED ADMISSIONS SYSTEMS

The development of automated college admissions systems parallels some of the events that have taken place over the last twenty years in higher education. In the mid-1960's, when most larger schools were beginning to automate many of their administrative systems, the words "enrollment decline" were unheard of. In the process of automating the admissions systems of the time, emphasis was placed on duplicating the existing manual systems -- systems that were based on the receipt of a completed application form from a student. A prospective student requested an application form, completed it, and returned it to the school's admissions office for processing. If accepted for admission the student could possibly enroll at the institution, or decided to cancel his/her application. Whatever student recruiting that was done was limited to this pool of applicants.

B) The student's social security number is generally not available at the time of record initiation, and cannot be utilized as a unique record identifier

C) Varying amounts of data can be present at the time of record initiation — minimally the student's name and address are needed

D) Records are subject to constant updating as new information concerning the student is received

E) The system may contain a high volume of records, perhaps ten times the usual number of applicant records.

Since its beginning on second generation computing equipment in the late 1960's, and after a conversion to more modern hardware in 1978, the admissions system at Saint John's University has been an inquiry based system. A student record was initiated on the system upon initial student contact, and it was possible to track students from their initial contact, through their final admissions decision.

During the last several years the university has participated in the Student Search Service of the College Board, and recently the new Educational Opportunity Service of the American College Testing Program. Typically, 20,000+ pre-selected prospective student names and addresses are received from Student Search on gummed labels and are used for an informational mailing. When the student responded to the mailing by returning a response card, i.e., the student inquiried for additional information, a record for him was initiated on the admissions system, and an application form sent out. Although it was quite easy to follow-up on those students who inquired, but did not apply, it was not possible to conveniently follow-up on those students who were sent the original mailing, but who did not return their response cards.

For the last two years student search data has been received in the form of a computer tape file that allows the university to produce its own mailing labels, and also provides the opportunity to "reuse" the data for follow-up mailings. Having the student search data available in machine readable form proved to be a mixed blessing for both the admissions office and computing center staffs. Follow-up mailings to non-responding students were a possibility, but the inconvenience of separating respondents from non-respondents still existed. It was also not possible to directly add the data to the admissions system for fear of creating a number of duplicate records for the same student. This would only add to the confusion in subsequent mailings with many students receiving two or three promotional pieces. The computing center staff was also beginning to be inundated with requests for reports from the student search tape. Although such reports were possible to produce, it became increasingly apparent that, unless the data from various external sources could be consolidated into the current admissions system, separate "systems" would begin to develop around each of about six external data sources.

GOALS OF THE PROJECT

The challenge at hand then was to develop a record matching technique that would allow data from various external sources to be reliably matched with that currently on the admissions system. To be considered successful the matching technique would have to meet the following goals:

A) Be based on data elements common to both existing student records and those from external sources

B) Work with data from various sources; both highly data intensive sources such as the ACT/SAT test reports, and such minimal data sources as Student Search and Educational Opportunity records

C) Significantly reduce manual duplicate record checking and record updating

D) Minimize the generation of duplicate student records

E) Be highly reliable.

DATA UNIQUENESS

Over a year's time a number of experiments were performed with a test file of 25,000+ records to determine what combinations of data elements, e.g., first and last name, telephone number, zipcode, etc., could produce an unique and reproducible record identifier that could serve to match external source records with those already in the admissions file. The experimental results indicated that no totally unique identifier could be produced that would serve a useful purpose. Unique identifiers could be produced from the test data, but required so many data elements that they were not reproducible from the data contained in the admission system records.

The experimentation did, however, produce some indication as to the level of uniqueness of various data elements. Social security numbers (present in some records only) and telephone numbers proved to have a high degree of uniqueness. Some student names, e.g., Zymond Zyvifkovitch, tend to be unique, where as others, e.g., John Smith are not.

KEY INTERFACE TECHNIQUE

The record matching technique that was finally settled upon was one that incorporated the various levels of uniqueness of four data elements into a hierarchy of uniqueness. The four data elements that were selected based on the experimental results were: social security number, telephone number, high school code, and zipcode.

Each of the data elements is used together with parts of the student's first and last name to produce a key record that is loaded to an intermediate key file (figures 1, 2). It is this key file that serves as an interface between student records in the external data source, and those in the admissions student master file (figure 3).

Portions of the student's name were incorporated into the key record in order to give those data elements with lower levels of uniqueness, e.g., high school code, zipcode, a higher degree of uniqueness. This procedure guaranteed that data from some sources, i.e., SSS, EOS, which do not contain social security and telephone numbers, would be processed just as reliably as those records that do, i.e., ACT/SAT test report tapes.

Before processing data from any external source the intermediate key file is generated from data contained in the admissions student master file. During this processing step 1-4 key records per student record are produced depending upon the presence of the four data elements in the record. An active admissions master file of 31,000+ records produces on the average 2.2 key records per student with a 99.8% of the key records being unique. The majority of keys produced tend to be high school code and zipcode keys.

EXTERNAL DATA SOURCE PROCESSING

Regardless of the external data source two facts are known: some of the student records will be duplicates of those already on the university's admissions system, and some will be new records. The successful separation of records into these two categories requires a two step process.

In the initial step (figure 4) the external data is run through a computer program that formats the data into a record format that is compatible to the university's admissions system. Due to the different record formats used by each of the external data sources, a separate formating program is used for each external data source. During the formating process a determination is made as to whether an external record is "new" or a "possible" duplicate. This determination is accomplished by repeating the key generation process described above for each of the external data records. The 1-4 key records are generated and an attempt is made to write these new key records to the previously generated key file. If a successful write occurs, the external student record is considered new, since no other student record on the admissions system has produced the same key record. New student records are written to a file to await addition to the admissions student master file by a separate computer program. The determination of the "new" student record status has proven to have a high degree of reliability, 98-100%, depending on the external data source.

The "possible duplicate" status is determined when a key write attempt has failed -- a student record on the admissions system has already produced a key similar to that of the external data record. The records are considered possible duplicates at this time since some identical lower level keys can be produced for two entirely different students, i.e., students with common names living in the same zipcode area. Possible duplicate records are written to a file to await further processing by a separate update program.

DUPLICATE RECORD PROCESSING

The second phase of record processing involves the possible duplicate record file produced by the formating program (figure 5). The possible duplicate file is processed by a computer program that determines whether or not the record can be considered an actual duplicate record. This determination is made by comparing the possible duplicate record with its match record on the admission system. If social security numbers are present in both records these are compared, and if equal, a positive match is assumed, and the existing student record is updated with any new information contained in the external record. If social security numbers are not available for either of the two records, then the student names are examined, and if the names agree in both records, a match is assumed and the existing record updated.

In those cases where positive matches do not occur, both records are outputted to an exception report. At this point there is a possibility that the two records belong to the same student, but, because of name variations (Tom/Thomas, Bill/William, etc.) a positive match was not obtained. The exception report is reviewed by a clerk who makes the final determination as to whether or not the records are duplicates. The clerk either updates a duplicate record, or adds a new student record to the system using an on-line add/update program. During the last several months that the record matching technique has been used 2,974 duplicate records were processed with only 173 (5.8%) needing manual reconciliation by a clerk. Most of the records needing reconciliation tended to be actual duplicates due to name variations.

Another function of the updating program is the verification of a number of existing data elements common to both the external data record and the admissions master file record. For example, if both contained telephone numbers no updating would have taken place, but a check would be made to ascertain if the numbers were identical. Any discrepancies are outputted to the exception report for reconciliation by a clerk.

ADVANTAGES/DISADVANTAGES

Since the record matching technique has been implemented a number of distinct advantages have become evident:

- A) Savings in both time and money in the processing of ACT/SAT test results data
- B) Expanded student recruitment pool integrated into a unified system
- C) Expanded use of student search data with more follow-up opportunities
- D) Ten-fold increase in admission records with no increase in clerical staff
- E) Less manual record processing, and less data entry errors
- F) Routine processing of all external data sources
- G) Market analysis statistics are available for all prospective students, not just for those who responded to an initial mailing.

Although the results of the technique has been overwhelmingly positive, a few disadvantages have resulted due mainly to the ten-fold increase in the number of prospective student records on the admission file. These include:

- A) Increased computer storage space/cost
- B) Longer processing time for routine selection programs
- C) Need to use selective reports rather than complete file reports.

COST BENEFITS

During the last several months of operation over 31,000 records were processed using the described matching technique. If these records were processed using manual data entry techniques over 2,600 hours of labor would have been required. Assuming work study wages of $3.75 per hour over $9,800 would have been spent in accomplishing this task.

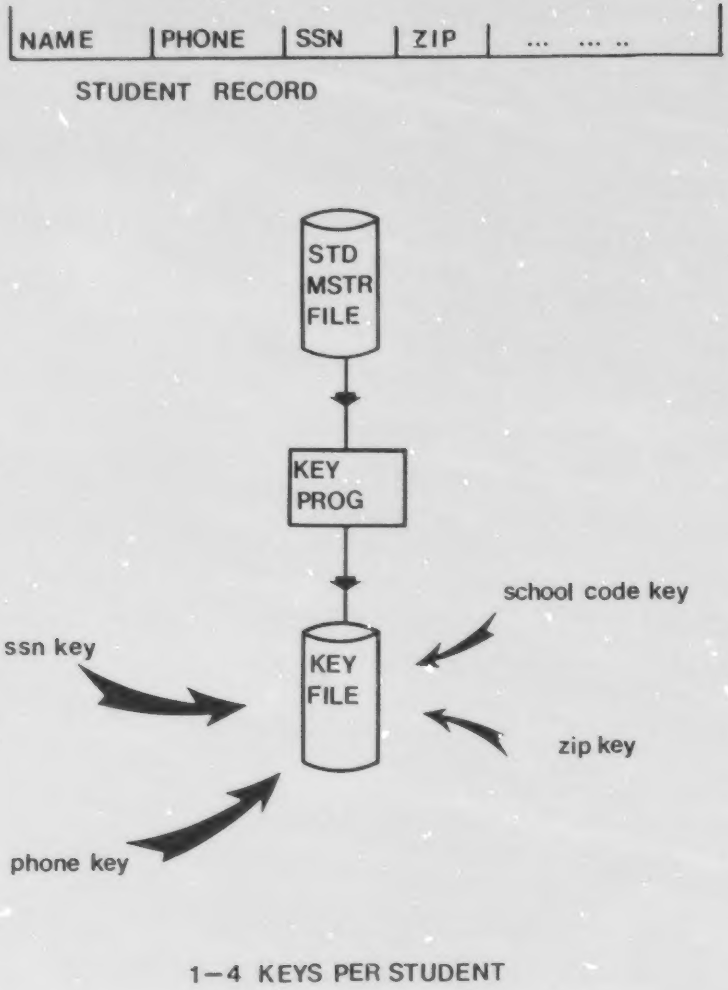
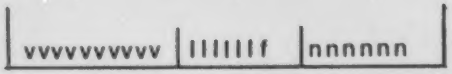

NAME
PHONE
SSN
ZIP
... .
STUDENT RECORD
STD MSTR FILE
KEY PROG
KEY FILE
ssn key
school code key
zip key
phone key
1–4 KEYS PER STUDENT

Figure 1

KEY RECORD FORMAT


vvvvvvvvvv
lllllf
nnnnnn

vv···vv	SSN or PHONE or SCHOOL CODE or ZIP
llllllf	6 LAST NAME 1 FIRST
nnnnnn	ID NUMBER

Figure 2

INITIAL FILE PROCESSING

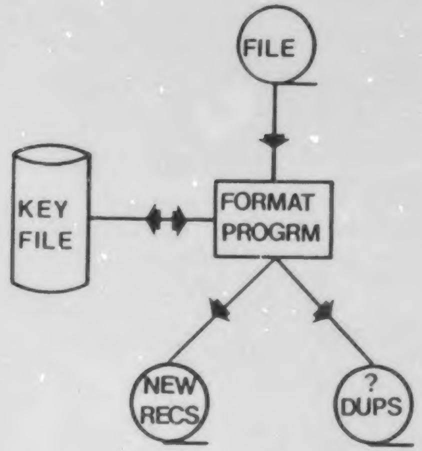

FILE
KEY FILE
FORMAT PROGRM
NEW RECS
? DUPS

Figure 4

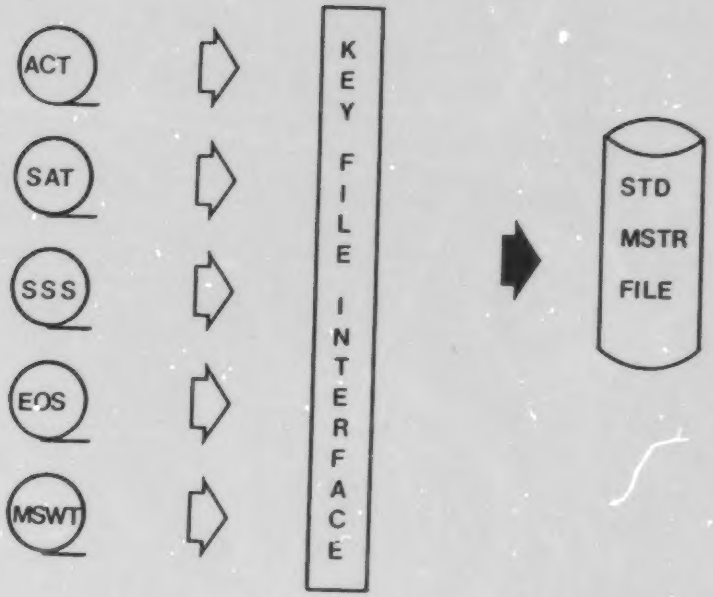
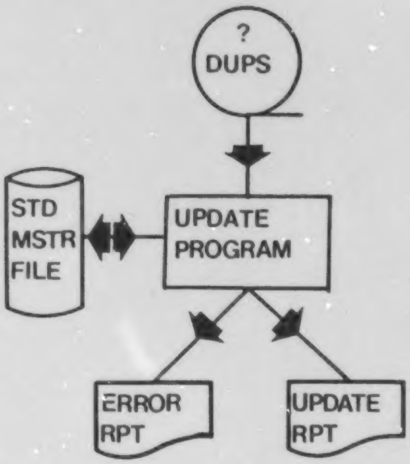

ACT
SAT
SSS
EOS
MSWT
KEY FILE INTERFACE
STD MSTR FILE

Figure 3

DUPLICATE RECORD PROCESSING


?
DUPS
STD
MSTR
FILE
UPDATE
PROGRAM
ERROR
RPT
UPDATE
RPT

VERIFIES:

- school code
- year of entry
- term of entry
- phone no.
- etc.

Figure 5

AN INTERACTIVE RESERVATION-REGISTRATION SYSTEM FOR CONTINUING EDUCATION

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MORROW, GEORGIA

A relatively rapid system for reservation and/or registration of Continuing Education (non-credit) students is described. The system was developed on a Texas Instruments 990/10 computer system in COBOL, and makes extensive use of a few function keys. System features include provision for reservation and waiting lists, a simple mechanism for reassignment of reserved spaces to waiting students if reserved student fees are not paid on time, easy access to individual student records, and a variety of reports for local system management and for satisfying requirements of external agencies.

Clayton Junior College, located in south metropolitan Atlanta, is one of 15 community colleges within the University System of Georgia which is composed of a total of 33 colleges and universities. It has a very active Community Services program of non-degree Continuing Education, by far the largest program of any other state community college. In fact, for Fiscal Year 1983 the 557 programs offered were exceeded only by the University of Georgia, Georgia State University, and two four-year colleges.

With a dynamic, service-oriented Director of Community Services having joined the college administration approximately 18 months ago, it now appears that the college's number of programs, participants, and participant hours for the current fiscal year will be exceeded only by the two universities.

Each quarter, the Community Services Department publishes and mass mails a newpaper-type brochure listing all courses to be offered, indicates a two-week interval during which registration will be conducted, and for registration both by mail and in person suggests that the student first phone in a reservation. Although efforts continue each quarter to provide enough classes to meet the expected demand, approximately 30 per cent of classes offered each quarter develop waiting lists.

Prior to the current reservation-registration system, the college had in operation a batch-oriented system which received student information only after the student had paid fees. The Community Services Department was attempting, in a rather haphazard way, to maintain reservation and waiting lists manually.

Thus, the new system needed to include the following:

1. Provide for the student to either (a) enroll in a class by payment of fees; or (b) reserve a space with subsequent fee payment; or (c) be placed on a class waiting list if all spaces are reserved.
2. Provide a simple mechanism for reassignment of reserved spaces to waiting students if fees are not paid within a specified time.
3. Provide for rapid entry of minimum information for reservations.
4. Provide a system which is simple for the terminal operator to use.

The system was developed for use on the Texas Instruments 990/10 computer system under the DX/10 Operating System in the COBOL language. Televideo 950 terminals, modified to emulate the Texas Instruments 911 Video Terminal, are used for interactive processing.

Basically, four procedures are involved in the reservation-registration operation: REGI, the main procedure for reservation-registration data entry; DEACT, which "deactivates" non-paying reservation students and reassigns the reserved space, on a priority basis, to waiting list students; CALLRPT, a listing of these reassigned students (and remaining Waiting List students) to be called to verify continued desire to enroll; and

CONTAX, an interactive procedure to input the information obtained from the use of CALLRPT.

Considerable effort was expended in the development of REGI to make it as simple as possible for the user. The result includes carefully considered terminal screen layouts, succinct instructions directly on the screen, command entries involving at most a single key stroke, and easy exit from any data entry sequence through the use of either the SEND key to "send" entered data to the computer, or the CMD key to "cancel my data" and ignore the sequence of entries.

In the typical case of the terminal operator accepting a telephone reservation, the operator, given a choice of options, enters A (for ADD), after which a 3-digit course sequence number is requested. As the prospective student is telling the operator which course is desired, an alphabetical listing of all courses is being scanned by the operator, with the appropriate sequence number keyed. This results in the Course Title being displayed, plus the number of remaining spaces and number on the waiting list, with request for the student name to be entered. All screen activity thus far has been on the bottom 3 lines to reduce eye movement. When the name has been entered, provision for entry of all data elements which will ultimately be needed is displayed in the middle of the screen. Two of these elements are DAY PHONE and NIGHT PHONE, at least one of which is considered to be the minimum data entry to constitute a reservation. Thus, use of the SEND key after either or both of these telephone numbers is entered completes the reservation process.

Assignment of student status is done internally by the program. If space is available and only name and telephone numbers are entered, the student is RESERVED. If no space is available, the status is WAITING. If space is available to a walk-in registrant with payment in hand and the FEE PAID element is entered, the student is ENROLLED, a receipt number is generated internally, the current date is assigned to the REGISTRATION DATE element, and a Receipt Form is printed. Each RESERVED student is also assigned a Registration Date, a computed date 5 days later than the entry date. In practice, this date is used by the DEACT procedure at a later time to identify RESERVED students who have failed to meet the fee payment deadline.

For each course, as each student enters the system, a "queue number" is assigned. This number not only provides, along with the course sequence number, a unique key for the student record; it also ranks students in order of entry, an important step in reassignment of reservations to WAITING students.

In addition to activities associated with original data entry, the REGI procedure can purge a student placed on file through error, or "drop" a student (which keeps the student on file and requests the drop date for later fee refund determination).
If the student purged or dropped is in a course with WAITING students, the highest priority WAITING student is changed to

HOLDING status, for later action by the CALLRPT and CONTAX procedures.

One of the most useful features of REGI is its updating capability. Since for most students only a minimum amount of information is originally keyed, the record must be retrieved for further data entry. With the UPDATE (user enters U) option, after entry of the course sequence number, the user typically enters only the first or first two letters of the student name which results in a display in the middle of the screen of up to 9 students whose names begin with these letters. If more than 9 students in a class have names in the range selected, and the student desired is not on the screen display, use of the F1 key will display up to 9 more names. Each name on the list is preceded by its order on the screen, 1 through 9. (Also displayed are DAY PHONE, NIGHT PHONE, and student STATUS.) When the name desired is seen on the screen, further entry of the single digit for this student will cause the full statistical record for the student to be displayed on the middle of the screen.

This easy method for looking at student records is also available with two more options in REGI: INQUIRE and VERIFY. The INQUIRE option can quickly access any student record, but is also useful in scanning quickly an entire class roll. For example, if only space is entered when student name is requested, the first 9 students are displayed. If the F1 key is depressed, the next 9 students are displayed, etc. The VERIFY option emulates the operation of a Key Punch Verifier, ringing the terminal bell when keyed data does not match the original data. The F6 key emulates the Verify Correct key on the Key Punch, permitting keyed data to replace the original data.

The DEACT procedure is used, when appropriate, to place RESERVED students who have not paid fees by a designated date in an INACTIVE status, and place highest priority WAITING students in a HOLDING status. Although no data entry other than procedure name is required, it is a highly sensitive procedure, and is written so that only authorized users may run it. It scans the registration file for RESERVED students (in classes with WAITING students) whose Registration Date (computed and stored as the date 5 days past the original date of entry) is earlier than the date on which DEACT is run. Students thus found are changed to INACTIVE, and the highest priority WAITING students are changed to HOLDING.

Procedure CALLRPT generates a report, by course, for all courses with HOLDING students, listing in "queue number" order all HOLDING and WAITING students. This list is then used by Community Services staff to telephone HOLDING students on the list. If the person is contacted and wants the reserved space being held, this is noted on the report. If the person cannot be contacted within a reasonable time, or the person contacted no longer wants to enroll, this information is noted, and the highest priority WAITING person is called with opportunity to take the space originally assigned to the HOLDING student.

As the calling operation is completed for each course, the CONTAX procedure is run to enter the data noted on the Call Report. This procedure displays, by course, the same information generated by CALLRPT, and gives to the terminal operator options depending on the results of the calling operation. The actions change a HOLDING student who wants the reserved space to RESERVED; or changes the unable-to-contact HOLDING student to WAITING, or the RESERVED student no longer interested to INACTIVE, and changes the WAITING student replacing the HOLDING student to RESERVED.

One week after registration starts, DEACT, and then CALLRPT, is run daily, followed by daily calling and then data entry of results through CONTAX. Although this portion of the system by its very nature involves considerable manual effort, the Director of Community Services considers this feature of the system to be highly rewarding because it results in classes being brought to the maximum level of enrollment.

Several other procedures involving either terminal inquiry or printed reports are available to assist Community Services in the registration process, e.g., interactive monitoring of actual and potential enrollments, lists showing for each class the number of students in various categories (enrolled, waiting, etc.), etc. Other procedures are used to prepare for registration, e.g., data entry of classes to be offered, including time and place of offering, maximum enrollment, etc.

Finally, a variety of other procedures is available to manage student information from the close of registration through the completion of work for a quarter. These include procedures to generate class rolls; to generate certificate rolls as each course is completed, from which data is entered to post CEU (Continuing Education Unit) credit to transcript tapes; to generate ad hoc generalized statistical reports, student lists, and gummed address labels for specified student groups; and to produce the quarterly enrollment report required for submission to the Board of Regents of the University System of Georgia.

All programming is in structured COBOL and except for the extended screen-handling capabilities of the ACCEPT and DISPLAY statements meet ANSI COBOL standards. The major files in the system are key indexed files with alternate keys.

DEVELOPMENT OF A PLANNING AND INSTITUTIONAL RESEARCH SUBSYSTEM AT GRAMBLING STATE UNIVERSITY (GSU)

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ABSTRACT

This paper discusses how and why Grambling State University, a national and internationally known institution with a current enrollment of 4593 students, proceeded to develop and implement a Planning and Institutional Research Subsystem. The paper uses a case study approach in explaining the three primary aspects of the subsystem: (1) Grambling Institutional Data System (GRIDS); (2) Simulation and Forecasting Models; and (3) Management Reporting System.

The paper suggests that an institution can assure its success in developing a Planning and Institutional Research Subsystem by commencing the project with a carefully prepared design document and by implementing a simple version of the system at the outset. Lastly, the paper discusses how GSU has improved the allocation of the institution's available resources.

INTRODUCTION AND PERSPECTIVES

Grambling State University is a national and internationally known institution located in the rural North Central region of Louisiana. The university is a public institution which has traditionally served a predominant population of black students who are economically, educationally and socially disadvantaged. The institution has a current enrollment of 4593 students, of which seventy-four percent are housed in campus dormitories. Approximately ninety-five percent of GSU's students receive financial aid. GSU has 235 full-time faculty members.

Managing GSU has become increasingly complex in recent years. This complexity has been exacerbated by uncertain support, the steady rise in the cost of facilities, energy and instructional services, the greater demands for accountability by external publics, the decline in financial aid, the increased pressures created by the settlement of the Higher Education Desegregation Litigation in the State of Louisiana, the increasing number of high-risk students, and the ever-increasing demands for new and improved course offerings and expanded student services.

Most of the aforementioned problems are common to many institutions of higher education. However, these problems assume greater significance at GSU because they represent basic threats to the survival and self-sufficiency of the institution. GSU has no endowment fund or other assets that have revenue-generating potential. Additionally, extramural support from foundations and corporations has been minimal. Increased state appropriations are primarily contingent upon a funding formula that is enrollment driven. Therefore, GSU has limited power to control the flow of resources to its "coffers." Since the direction of resource flow at GSU is highly unstable and uncertain, top level management officials were compelled to devise a better way of managing and controlling those resources which the institution received via state appropriations. GSU's executive management had to make decisions - often crucial decisions - based on incomplete, inaccurate, untimely and inadequate information. Data and information which were necessary for optimal decision making and strategic planning were not readily available.

Consequently, the allocation of available institutional resources was made primarily on the basis of "seat of the pants judgments" and "relative urgencies." There was an obvious need to develop a mechanism for the systematic and rational allocation of available resources.

COMPUTING ENVIRONMENT

The university is currently engaged in a program to strengthen its management capabilities. This program is funded primarily by a Title III grant from the U.S. Department of Education. The State of Louisiana has supplemented the Title III funds by providing for some specific items, e.g., computer hardware.

The program included an effort to formulate and develop a management development and training program for professional and non-professional staff members to upgrade the managerial skills of those with administrative responsibilities. Another part of the program, the subject of this paper, was aimed at providing better information on a timely basis to all levels of GSU's management. GSU's managers had to rely on limited staff efforts to satisfy only a portion of their information needs. For the most part, reports were generated manually, rather limited in scope, and frequently completed long after they were really needed. There was an apparent need for most of this information to be generated by the GSU computer center so that managers could have accurate, comprehensive and timely data on the university's operations and programs.

The capabilities of the GSU computer center to support administrative functions have been enhanced in recent years by upgrading and adding computer hardware and software. This evolutionary process has led to the current PDP 11/70 computer configuration with 608K words of core memory and 176M bytes of disk storage space. It currently supports 37 remote terminals for instructional and administrative users. In the near future, an additional, medium-sized mainframe computer (VAX 11/780) will be installed to establish a dual hardware configuration. Current plans call for the VAX to be dedicated to instructional and research use, making the entire PDP 11/70 system available for administrative use. This will result in a dramatic increase in the potential for providing administrative support. Additional terminals will be installed to facilitate computer access by all administrative users.

The collection of software available at the GSU computer center has been expanded to include the major general purpose computer languages and standard statistical package, i.e., COBOL, FORTRAN, BASIC-PLUS, PL/1, RPG, SPSS and MINITAB. The POISE Data Management System has been installed along with most of the available POISE modules. These include: (1) Data Management System, (2) Financial Accounting System, (3) Registration and Student Records, (4) Payroll System, (5) Student Billing/Receivables, (6) Financial Aid System, (7) National Defense Student Loan, (8) Personnel System, (9) Fixed Assets, (10) Alumni/Development, (11) Inventory System, (12) Admissions System, (13) Position Control System, (14) Student Affairs - Housing, (15) Student Affairs - Student Life, and (16) Library System. All of these are either fully operational now, or will be within a few months. Other POISE modules for financial management and accounting will become operational in the near future. These POISE modules are the major transactional information systems (TIS) in use at GSU.

Other, more specialized, software include: (1) Enrollment/Recruiting (2) Long-Range Planning/Budgeting, (3) Instructional Cost Index, (4) Resource Allocation, (5) Tenure, (6) Resource Requirement, (7) Unduplicated Head Count Enrollment, (8) Salary Planning, (9) Student Information, and (10) Productivity Indices. These have been developed by the Office of Planning and Institutional Research to support some of the planning, management and evaluation (PME) functions. In the past, PME analyses were conducted on an ad hoc basis, largely without adequate computer support. This deficiency has been overcome by the development of additonal software, specifically designed to support the PME function.

GSU plans to improve the computer support for administrative operations by expanding its on-line, interactive capabilities, and by developing a hierarchy of information systems (HIS/MIS) over the next five years. The impending installation of the VAX 11/780 for instructional and research use will contribute significantly by increasing the practical limitations on the number of simultaneous, on-line administrative users which can be accommodated. The HIS/MIS will enhance and strengthen GSU's management capabilities by providing the information necessary to support administrative activities at all levels. The HIS/MIS include (1) Transactional Information Systems (TIS) for the routine daily operations of the university, the Management Information System (MIS) which produces analytical reports from the TIS data base for institutional managers, and (3) the Planning and Management System (PME) which further integrates transactional data and external information to support planning and management decisions.

PURPOSE

The purpose of this paper is to describe how GSU developed and implemented a Planning and Institutional Research Subsystem to improve the effectiveness and quality of decision-making at the institution. Moreover, the paper discusses how the system provides timely, accurate, and comprehensive information about the efficiency of GSU's operations and program offerings to effectuate a more productive utilization of the university's limited resources.

Having as its primary emphasis the providing of decision support to GSU's executive management, the computer-based planning information system has three primary components: (1) Grambling Institutional Data System (GRIDS), (2) Simulation and Forecasting Models, and (3) Management Reporting System. These three components will be discussed later in the paper.

WORKING DEFINITIONS

For purposes of this paper, "planning" and "institutional research" will be used interchangeably. Likewise, "subsystem" and "system" will be used in the same manner.

The Planning and Research Subsystem is called a "subsystem" because it is a functional subsystem of the HIS/MIS. More specifically, for this paper we will use the following definition of a subsystem:

> A functional subsystem of an MIS is a defined set of internal, official, and formal management procedures and processes by which data and information, including reports, on which management decisions and information releases on a selected area of organizational functional activities can be based, are furnished to executives and administrators of an organization. (McManis, 1978, p. 6)

LITERATURE REVIEW

A crucial step in the design and development of GSU's Planning and Research Subsystem was the identification and selection of an appropriate conceptual framework. In reviewing the relevant literature, it was discovered that Comstock (1970), Sheehan and others (1972), Haight and Romney (1975), Lawrence and Service (1977), Lasher (1978), McManis and Parker (1978), Sheehan (1980), and Doty and Krumrey (1982) conceptualized some fundamental ideas about the development of a hierarchy of information systems.

After careful study, the Office of Planning and Institutional Research (OPIR) decided that the paradigms suggested by Sheehan (1980), McManis and Parker (1978), and Doty and Krumrey (1982) provided the necessary conceptual framework for the design and development of the Planning and Research Subsystem.

Sheehan's paradigm (1980), as evidenced in Figure 1, presents a hierarchy of information and categorizes them into three levels: (1) Transactional Information Systems (TIS), (2) Management Information Systems (MIS) and (3) Planning and Management Systems (PME). The essential foundation of the hierarchy at the first level (TIS) of operation is data collected in the regular and routine activities of the institution. The second level in the hierarchy (MIS) will produce analytical reports from the TIS data base for institutional managers. At the highest level (PME) is the further integration of transactional data and external information to support planning and management decisions. (p. 512)

(Figure 1 presented as a transparency)

Doty and Krumrey (1982) in their paradigm stress the fundamental differences between the operation support system and the decision support system (See Figure 2). In their framework the objective of an MIS is to convert voluminous raw data into useful information for management decision making. Integration of the operation support and functional systems into one consolidated business management system provides the mechanism by which a manager receives information to conduct analysis and to solve problems. (p. 21) Notice that the paradigm includes a planning, control and measurement system as an essential part of the decision support system.

(Figure 2 presented as a transparency)

In the paradigm formulated by McManis and Parker (1978), the institutional research and planning support module is a subsystem of the MIS (See Figure 3). The paradigm shows how the report production of other MIS subsystems will provide improved decision support to the continuous planning and institutional research needs of the university. Additionally, the model suggests that the planning and institutional research activities can be significantly enhanced by a subsystem which is capable of generating special (one-time) reports as required. The existing computerized data banks or a central MIS data base provides the essential data for these reports. A general purpose report generator capability can be created to support the institution's executive and administrative management by linking all of the existing data banks to the planning and research subsystem. (p. 50)

(Figure 3 presented as a transparency)

McManis and Parker (1978) formulated the specific design requirements of planning and research subsystems. These requirements are the operational functions and the report production capabilities of the system.

(Figure 4 presented as a transparency)

The conceptualization of McManis and Parker (1978) was employed in justifying a request for Title III funding and in the ultimate development of GSU's Planning and Research Subsystem.

METHODOLOGY/APPROACH

The case study method was selected in order to provide sufficient detail and analysis to illuminate the process by which GSU developed its Planning and Institutional Research subsystem. This approach was also used to indicate how the subsystem was employed in supporting and improving the process of decision making, especially the allocation of the institution's limited resources.

The case, as presented, is nothing more than a description of a real-life institutional problem. However, the author believes that this case can serve as a useful teaching and learning device in that it evidences how theoretical and conceptual frameworks can be applied to an actual problem or situation.

DISCUSSION

When GSU implemented its planning process on September 1, 1980, the process was not supported by a reliable and comprehensive data base. GSU's executives and administrators were convinced by the Executive Director of Planning and Institutional Research that current and reliable information was a basic ingredient for effective decision making in the implementation of a strategic plan and in the evolution of outcomes of the strategic planning and budgeting process. Moreover, the administration was made aware of the need to develop a system for collecting and assimilating data so that the university could make expeditious responses to requests of external agencies for information about its programs and operations.

Recognizing that the quality of planning could not consistently arise above the quality of information on which it was based, the university took some necessary steps to improve the planning technology at the institution. As used here, "planning technology refers to the information systems (institutional and non-institutional data bases), the data processing systems (manual and semi-automated as well as computer hardware and software) and the analysis and research techniques that serve the planning function." (Peterson, 1980, p. 116)

An important step in improving GSU's planning technology was the development of a Planning and Institutional Research Subsystem. During the summer of 1982, the Executive Director of Planning and Institutional Research decided that the conceptual framework of McManis and Parker (1978) provided an excellent basis for the design of the subsystem. It was also decided that the subsystem would have three primary components: (1) GRIDS (Grambling Institutional Data System); (2) Simulation and Forecasting Models; and (3) MRS (Management Reporting System). To assure success in developing the system, a design document was carefully prepared with the assistance of an external consultant. The design document was completed during the month of September, 1982, and it contained the desired system capabilities. The design document included detailed discussions of the data base structure, the extraction and report generation procedures and the necessary steps to implement the subsystem.

Five important principles were utilized to govern the implementation of the subsystem:

- User motivation - Every employee involved with the system must be motivated to use it properly; conversely, the system must be designed to aid in the motivation.

- Early results - The system development should be organized in such a way that tangible system outputs are produced early, preferably within the first year.

- The simple approach - As the system is being developed, managers should favor consistently the simple approach. To the extent that simplicity can be achieved, the chances of realizing a successful system increase.

- Maximum system flexibility - An organization should not expect to achieve the optimum system on the first go-round. The system design should be an iterative process, in which the results of experiences are built upon to improve the capabilities and responsiveness of the system.

- Data purification - It is necessary to develop standard-data definitions and promulgate them to all potential sources of data for the information system. Also vital, is the review of historical-data to determine how it can be incorporated into the information system data base without distortion. (Comstock, 1970, p. 194)

GRIDS

The Grambling Institutional Data System (GRIDS) was developed for the Office of Planning and Institutional Research. It is designed to run on the PDP 11/70 at the GSU Computer Center. It consists of a historical data base and a collection of extraction and reporting routines to produce formatted tables using the contents of the data base. The historical data base contains two types of information -- academic and financial. The academic information has to do with students, faculty, courses, credit hours, etc. Aggregate data are included for each of the academic departments. In addition, summary data are included for each of the several colleges and for the entire university. The data base also contains financial and/or budgetary information. Data are included for the GSU planning and budgetary units, such as the President's Office, Registrar's Office, Admission's Office, and each of the several colleges. The system uses the POISE Data Management System to extract data from the data base and to produce desired reports.

To facilitate the evaluation of trends, data are included for each of five academic years wherever possible. The fact that data are included at an aggregate level rather than at the individual student and faculty member level imposes some restrictions on the types of reports which can be generated. Basically, this means that when breakdowns below the department level are needed, they must be included as such in the data base. Thus, for example, if the number of Black faculty members is required by department, this must be included as a separate data element.

The scope of the data included initially was restricted to selected data elements for the five academic years 1976-77 through 1980-81. This allowed the system to be implemented without delay, since the OPIR could provide the data to the computer center in that form with a minimum of effort. Other data elements for these years and complete data for 1981-82 were added later, after GRIDS was operational and the OPIR had gained some experience with its use.

GRIDS has been used to produce a variety of reports which display either 5-year trends in selected data elements or a collection of data elements for a single academic year. These reports provide breakdowns by individual academic department or planning unit. The system provides for three basic report formats (Copies of the three GRIDS report formats are available upon request from the author).

The first standard format is designed to show the five-year trends in a chosen data element, for example, full-time enrollment, for each Grambling academic unit. Thus, each row corresponds to a department or college and each column corresponds to an academic year.

The second standard format is designed to show the five-year trends of selected data elements for Grambling as a whole. Thus, the X_1, X_2, etc., in the rows correspond to different data elements. For example, these could be full-time enrollment, etc., as required for an enrollment report.

The third report format is cross-sectional in nature, that is, all data pertain to a specific academic year. The rows correspond to individual academic units, and the columns now correspond to different data elements. Thus, one can compare a collection of data elements at the department level.

The layouts presented above correspond to reports to be generated from the academic data files. Reports from the financial data files are similar, except that the breakdowns are given in terms of planning rather than academic units, i.e., the President's Office, Registrar's Office, Admission's Office, individual department level.

Other reports were constructed using the POISE Data Management System on an ad hoc basis.

After the initial implementation, the GRIDS data base was expanded to include all of the data elements which the OPIR required. Additional POISE procedures were written to provide percentage distributions, year-to-year changes, and trend projections directly in various reports. It is important to point out that the OPIR implemented the simple version of GRIDS described in the design document. The aforementioned additional capabilities were only added after the simpler version was operational.

SIMULATION AND FORECASTING MODELS

Simulation and forecasting models are an integral part of Grambling State University's computer-based planning information system. The development of the following simulation and forecasting models has provided the management team at Grambling State University with a systematic and orderly method of analyzing policy:

(1) Enrollment/Recruiting
(2) Long-Range Planning/Budgeting
(3) Instructional Cost Index
(4) Resource Allocation

(5) Tenure
(6) Resource Requirement
(7) Unduplicated Head Count Enrollment
(8) Salary Planning
(9) Student Information
(10) Productivity Indices

It is important to point out that these models were initially developed on a TRS-80 microprocessor and later refined and stored in the memory of the PDP 11/70.

The simulation and forecasting models were employed at Grambling State University to provide estimates of future student body and faculty characteristics, facility utilization and revenues and expenditures. The forecasting models ranged from simple, linear trend projections to more sophisticated multivariate analyses. The simulation models provided the additional capability to measure the sensitivity and/or stability of results to changes in hypothesized inputs.

The models were varied in scope and technique. Therefore, it was not feasible to provide software, which was sufficiently general, to encompass them all. A certain amount of capability to project trends in key data items was afforded by GRIDS.

Simulation and forecasting models were central to the planning function at Grambling State University. These models provided rational criteria for weighing the range of available alternatives and the resources required for implementation.

MANAGEMENT REPORTING SYSTEM

GSU's Management Reporting System was developed so that evaluation of the outcomes of the university's strategic planning and budgeting processes could take place. After unit plans had been approved for implementation, the OPIR had to determine a suitable approach to integrating these plans with MBO in order to systematically monitor and evaluate progress in achieving objectives.

GSU's unit plans were designed to delineate clearly annual objectives. The plans, therefore, were easily translated into an MBO system which was computerized so that regular reports were produced to give managers a constant flow of information on the status of their operations.

A prerequisite for automation of the Management Reporting System (MRS) was the training of directors and supervisors in the use of the MBO process. Training materials were designed and training sessions were given. The sessions focused on three topics: (1) "The Contemporary Role of the Unit Manager"; (2) "MBO - A Tool for Monitoring and Evaluating Progress"; and (3) "The Use of the MRS in the MBO Process".

The development of the Management Reporting System has given the university the ability to translate its Five Year Planning Budget into annual operating plans.

For every major planning/budgeting unit at the university, the MRS will generate an Annual Operational Plan containing the following elements:

(1) Identity of reporting unit
(2) Name of responsible manager
(3) Names of individuals responsible for specific milestones (tasks)
(4) Statement of Purpose and Statement on Proposed Propitious Niche
(5) Objectives
(6) Performance Evaluation Measures
(7) Implementation Strategies
(8) Milestones
(9) Time Frames
(10) Budget
(11) Budget Notes

Elements 5, 6, 8, and 9 provided the fundamental basis of GSU's evaluation strategy. The evaluation of operational plans was an important phase of the university's planning and management system. Approved objectives became the agenda for a series of quarterly reviews. Each manager could chart his progress in attaining approved objectives through the utilization of a milestone reporting technique.

RESULTS

The development and implementation of GSU's Planning and Institutional Research Subsystem have greatly improved the institution's ability to carry out the three primary and ongoing functions of planning, managing and evaluating. It is my opinion that the system has brought about a more productive utilization of GSU's limited resources. Moreover, the system has been able to generate timely, accurate, and comprehensive information about the efficiencey of the institution's operations and program offerings. As an example, last year the university was able to reallocate $300,000 from non-productive programs to productive and high-growth programs.

IMPLICATIONS FOR PRACTITIONERS

All institutions regardless of size, during this era of dwindling resources and increasing accountability, will ultimately find a need to develop a capacity for the integration of transactional data in support of planning and management decisions. Institutions will also find a need to develop the capacity to evaluate the consequences of decisions as well as the alternative strategies available to decision-makers. The development of these capacities will enable the institution to improve on its method of allocating scarce resources during this period of economic uncertainty.

An institution can assure its success in developing a Planning and Institutional Research Subsystem by commencing the project with a carefully prepared design document and by implementing a simple version of the system at the outset. The design document should contain detailed discussions of the data base structure, the extraction-and-report-generation procedures, and the steps necessary to implement the system. In implementing a simple version of the system, the scope of the data included initially could be restricted to selected data elements for five academic years. Other data elements and other years could be added later, after the system is operational and the Planning and Institutional Research Office has gained some experience with its use.

After the initial implementation, the system's data base can be expanded to include all the data elements which are required.

Additional software procedures could be written to provide percentage distributions, year-to-year changes, trend projections directly in reports, etc. However, the simple version of the system should be implemented first. These additional capabilities should be added later after the simpler version is operational.

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Extracting Data From
Integrated Student Information Systems

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ABSTRACT

This paper describes an ISIS, how data are put into it, and how data are extracted from it for purposes of institutional research. The structure of the original ISIS files, the extract files, and theS PSS SPSS files is presented and the methods used for transferring data from one file to another are outlines. The methods used to develop and maintain the files in an interactive CMS computer environment are also given. Finally, the methods used to analyze the data using SPSS are presented.

Extracting Data From Integrated Student Information Systems

Introduction

Two years ago, we at Trinity University implemented an integrated student information system (ISIS). Figure 1 is a graphic representation of the way in which students are processed as they enter and progress through our institution. All of our data are maintained in our IBM 370-3031 computer. Each of the academic offices on campus contains computer terminals which permit persons who work there to access the database and to update or modify selected data elements in the database. When a prospective student applies for admission, a file for this individual is "opened" in the system and all of the application data are entered. Later, when the individual enrolls, he/she processes through the offices on campus. The file which was "opened" in the admissions office is available for expansion to the personnel in each of the other offices. As a student is processed through each office (registered, billed, housed, etc.), his/her data are entered into a single master file. Conducting institutional research from this database, where all of the data on students are held in the same place, is far different from conducting institutional research using a number of different data files which traditionally are separately maintained in a number of different offices. In our ISIS, the data for each student are loaded in the master file. The subsections of the master file for each student are cross-referenced. This arrangement makes it a relatively simple process to acquire data needed to conduct institutional research.

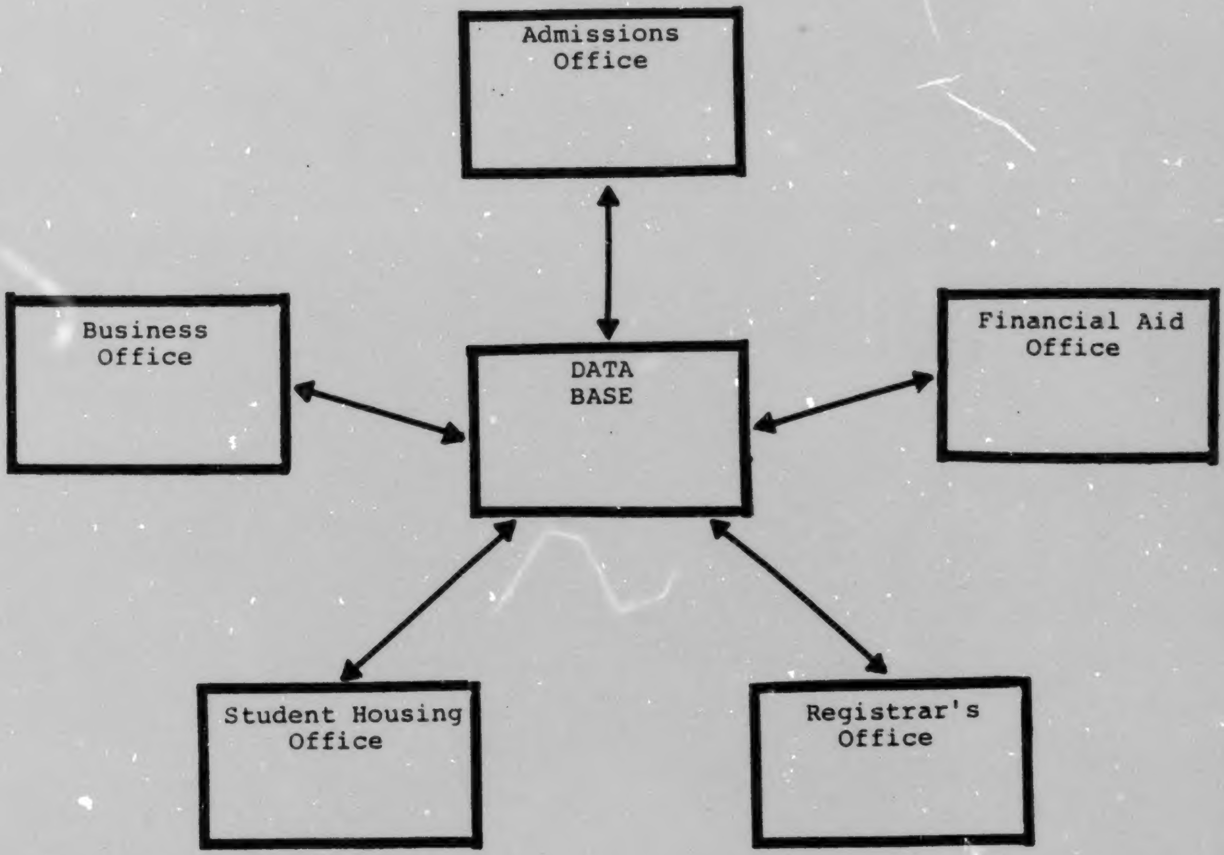
Data and File Structure

To understand how institutional research can be conducted using an ISIS, one must first understand which data elements are input, how the data are maintained, and how the files are structured. There are approximately 1500 variables in our ISIS. Many of the variables can have two or more entries for a given student, faculty member, or class. As a result, two students, faculty members, or classes seldom have the same number of variables in their files.

The data are input to the ISIS through 65 on-line terminal screens into 54 separate subfiles (See Figure 2).

Table 1

Record-Keeping Under An
Integrated Student Information System


Admissions Office
Business Office
DATA BASE
Financial Aid Office
Student Housing Office
Registrar's Office

In addition, some variables are maintained by the system and others are maintained through the use of batch programs which "roll" the data into particular fields. For example, a student's date of birth would be input on an on-line basis through a terminal; a bill for room, board, and tuition would be system-maintained on an on-line basis and automatically calculated; and the number of credit hours generated by a professor in a given course on the census day of a semester is maintained through a batch program which calculates the correct value and "rolls" it into the system. The batch or "roll" programs are ones which are run at specific times during a semester to update files which must all be updated at the same time in a semester or academic year.

The ISIS contains all student academic and personal data, all faculty data which deal with courses and teaching, all course data which deal with students, faculty, class meeting times, class meeting days, enrollment, buildings, the University calendar, catalog, and class schedules.

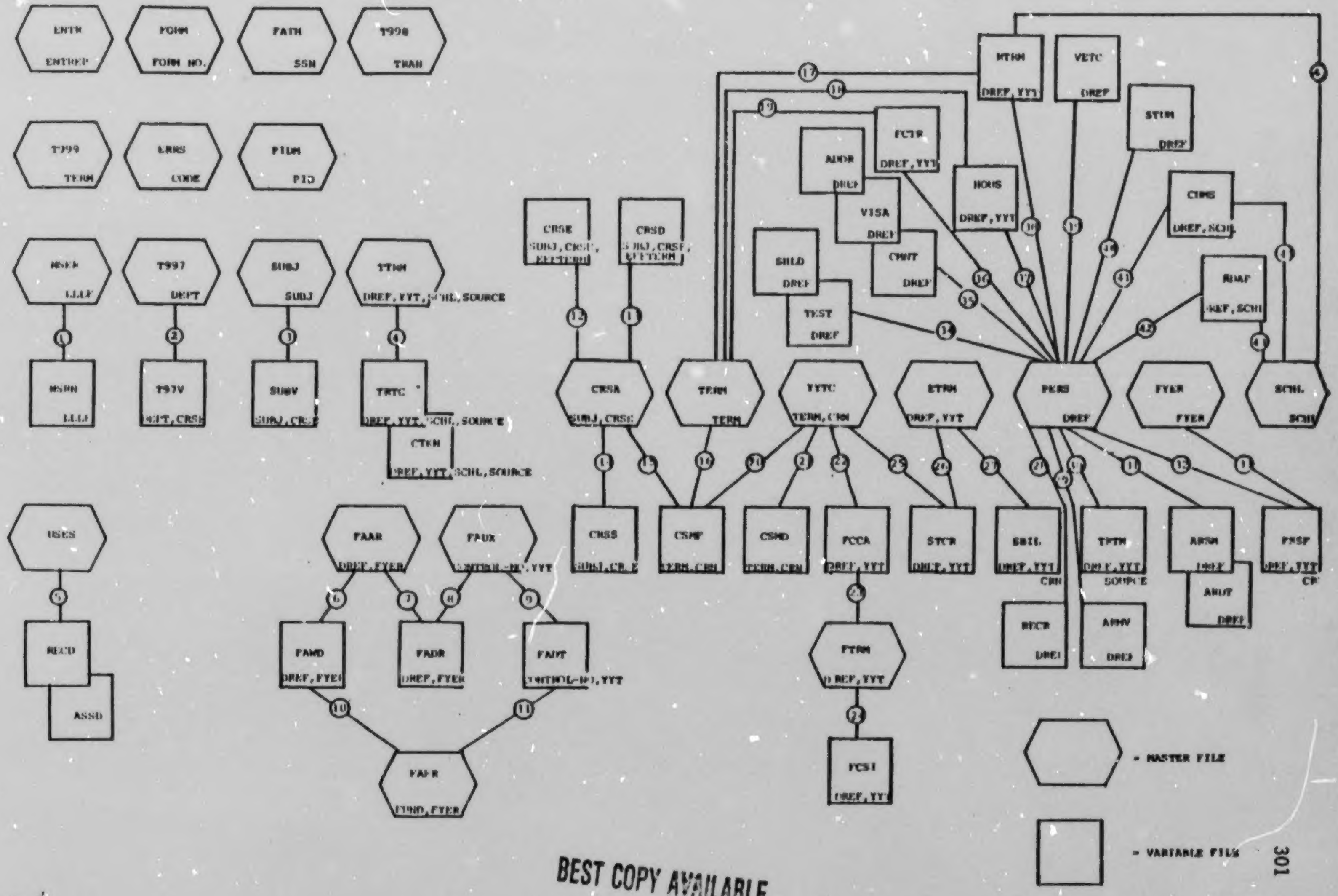
The majority of the ISIS files are BDAM (Basic Data Access Method) files. Several of the files are VSAM (Virtual System Access Method) files. TOTAL is used to manage the files in our ISIS.

Accessing Data

It is a relatively simple and straightforward process to access data on an individual student, faculty member, course, etc. in our ISIS. If a person has the proper passwords, he can sign on to the system at a terminal, and by using the appropriate codes he can call up the data that he wants on one or more terminal screens. If a printed copy of the information on a screen is required, there are several sites on campus where the information that has been brought up on a screen can be printed.

Along with the on-line programs which are used to enter and retrieve data for individual students, there are a series of batch programs which are used to develop standard reports. These reports are those which are periodically required by the individuals in the different offices on campus. The batch programs which prepare these reports were developed at the time our ISIS was designed and installed. The reports which these batch programs develop are similar to the ones which business and academic offices on campuses commonly use. The batch programs which prepare the reports are very functional for their intended use, but they are not very flexible

Table 2


ENTR
ENTREP
FORM
FORM NO.
FATH
SSN
T998
TRAN
T999
TERM
ERRS
CODE
PIDM
PID
MSEE
LLLF
MSRN
LLLL
T997
DEPT
T97V
DEPT,CRSE
SUBJ
SUBJ
SUBV
SUBJ,CRSE
TTRM
DREF,YYT,SCHL,SOURCE
TRTC
DREF,YYT,SCHL,SOURCE
CTRM
DREF,YYT,SCHL,SOURCE
USES
RECD
ASSD
FAAR
DREF,FYER
FAUX
CONTROL-NO,YYT
FAWD
DREF,FYER
FADR
DREF,FYER
FADT
CONTROL-NO,YYT
FAFR
FUND,FYER
CRSE
SUBJ,CRSE,EFFTERM
CRSD
SUBJ,CRSE,EFFTERM
CRSA
SUBJ,CRSE
TERM
TERM
YYTC
TERM,CRN
ETRM
DREF,YYT
PERS
DREF
FYER
FYER
SCHL
SCHL
CRSS
SUBJ,CRSE
CSMF
TERM,CRN
CSMD
TERM,CRN
FCCA
DREF,YYT
FTRM
DREF,YYT
FCST
DREF,YYT
STCR
DREF,YYT
SBIL
DREF,YYT
CRN
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VISA
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CMNT
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DREF
TEST
DREF
RDAP
DREF,SCHL
= MASTER FILE
= VARIABLE FILE

BEST COPY AVAILABLE

and do not produce data in a form which is useful for institutional research purposes. Also, the batch programs do not permit the development of ad-hoc reports which are often needed.

While the accessing of data in ISIS for a particular observation is relatively simple, obtaining aggregated data is a very difficult and complex task. When we purchased the license to use TOTAL as our database manager, we had an opportunity to purchase the license to a second portion of TOTAL which would have permitted us to access and aggregate data directly from the files. This second option costs approximately $40,000.00, and we decided not to purchase the license for it.

We, therefore, designed and developed three programs to extract the data from the ISIS to conduct institutional research and to develop ad-hoc reports. The first program extracts data from the ISIS on prospective students and/or persons who made application for admission (Prospect/Applicant Extract). The second program extracts data on graduate and/or undergraduate students who are enrolled (Enrolled Student Extract). The third program extracts data for all of the courses taught in a semester (Course/Faculty Load Extract).

An outline of the content of the Enrolled Student Extract is contained in Table 3. There are eight major divisions of the content of this extract. The first, or personal information portion, contains information on the sex, age, ethnicity, religion, etc. of each student. The second, or demographic portion of the extract, contains information about each student's parents and their occupations. Also, this section contains each student's complete home address as well as his/her address while enrolled at school.

The third, or academic history portion of the extract, contains information as to which high school the student attended, his high school grade-point average (GPA), and his/her high school rank. For students who are transfer students, the college previously attended, the GPA obtained at that college, and the number of credit hours obtained are also contained in the extract.

The fourth, or academic aptitude portion of the extract, contains the standard aptitude and/or achievement scores of each student. The ISIS itself permits the entry of any number of each of the types of standard scores and subtest scores. In instances in which a student has taken a particular test more than once, the extract program uses the highest score which the student has ever obtained on that test.

Table 3

Content of Enrolled Student Extract

1. Personal Information
2. Demographic Information
    - Home
    - School
3. Academic History
    - High School
    - Previous College(s)
4. Academic Aptitude
    - S.A.T.
    - A.C.T.
    - T.O.E.F.L.
    - G.R.E.
5. Recruiting Activity
6. Academics
    - Major(s)
    - Performance
    - Standing
    - Degree(s)
7. Financial Awards
    - Grants
    - Scholarships
8. Business Office Activities

Table 4

Content of the Course/Faculty Load Extract

1. Instructors
    - Name
    - Identification Number
    - Home department
    - Home division
2. Course
    - Identification number
    - Department identification number
    - Divisional identification number
    - Credit hours
    - Type (lecture, lab, etc)
    - Level (Graduate/undergraduate)
    - HEGIS number
    - Number of students ever enrolled
    - Number of students enrolled on the census day
    - Credit hours generated
    - Meeting days
    - Meetind hours
    - Meeting building
    - Meeting room

The fifth, or recruiting activity portion of the extract, contains information on the number of times a student and recruiter interacted, who the recruiter was, the types of information and/or materials which were given to a student, and the dates that the student and recruiter interacted. Basically, the entire recruiting history of a student can be reconstructed from the data contained in the extract.

In many ways, the sixth, or academic portion of the extract, is the most important. This portion of the extract contains the date which a student's application was received, the term which he/she entered college, the major which the student thought he would pursue when he made application for admission, the actual or the declared major of study, credit hours attempted, credit hours completed, advance placement credit hours, credit hours obtained by examination, transfer credit hours, degrees received, and the number of credit hours which a student has registered for in each semester of attendance. These last data elements (registered credit hours for each semester) have proven to be extremely useful in conducting institutional research studies. It is through the use of these values that full and part-time students are identified, that full time equivalent students are calculated, that a "head-count" is obtained, that the full-time equivalent of part-time students is obtained, that students who "sit out" a semester are identified, that students who do and do not preregister for a semester are identified, and that students who permanently drop out of school are identified.

The seventh, or financial awards portion of the extract, contains grants and scholarship information on each student. At Trinity, as at most schools, a student may receive a grant or scholarship from one or more of several different funding sources. The ISIS is capable of accounting for as many different grants and/or scholarships as a student may be given. Since the extract is an abbreviated version of the ISIS, not all of the information contained in the ISIS can be incorporated into the extract. We have found that by including the first five funding sources for each student, we have complete data on approximately 98 percent of students. We feel that the trade-off of space conserved in not including a sixth or seventh funding source for each student is worth not having complete information in the extract on two percent of the students. There are three pieces of information associated with each source of funding. The first is the identification number of the source of funding. The second is the status of the award (offered to the student, accepted by the student, rejected by the student, disbursed to the student, cancelled). The third is the number of dollars awarded to the student from the funding source. To reduce the total number of data elements which must be used in any analysis, the first two data elements (identification number and status) are formatted into a single data element. The first three digits of the new format account for the funding source and the last two digits indicate the status of that funding source for a student. Using this formatting approach has reduced the number of data elements in this portion of the extract from fifteen to ten, and has made analyses of the data much simpler without losing any of the information contained in the original data.

The eighth, or business office activities portion of the extract, contains information about each student's transactions at the business office. When our ISIS was developed, a unique set of receipting codes was developed. Each time a student completes a financial transaction in the business office, a receipt code is entered into the ISIS along with the dollar amount of the transaction. From an institutional research point of view, the transaction code is just as important as the dollar amount. Examples of several of the more frequently used transaction codes are: RDEP or room deposit; DDDP or dorm damage deposit; and TDEP or tuition deposit. Along with the transaction code, there is a one-digit numeric code which is affixed to the end of each of these codes to indicate whether a student is making a payment to the institution or whether the institution is refunding the money to the student. The extract contains the first five transaction codes for each student in each semester. Using the first five codes permits an analysis of the business office information for all students through the first month of each semester and for 95 percent of the students for the entire semester. That is, as the semester progresses, approximately 5 percent of the enrolled students have more than five business office transactions. In this case, as it was with financial awards, the conservation of space in the extract using this approach is worth not having some of the information available for analysis.

Each student's personal, demographic, academic history, academic aptitude, and recruiting activity data are input to ISIS at the time he/she enters Trinity. Very few changes are made to these data after they are entered. For the other data elements, however, new data are entered as they become available. Housing, academic, and the business office data are all maintained on a semester basis.

A person is considered to be a prospective student if he/she sends a letter of inquiry to us or if he/she fills out an inquiry card and sends it to us requesting information about our institution. As a result of the inquiry, we typically obtain some personal, demographic, academic, and/or aptitude information on a person whom we consider to be a prospective student. This information is usually self-reported, and is recognized as being self-reported and being subject to error and/or bias. A person who is classified as an applicant is one who has completed an application form, has paid an application fee (or had it waived), and has had official copies of materials forwarded to us. The data in the records of a student applicant are much more complete and reliable than the data in the records of a prospective student.

The data in the Prospect/Applicant Extract is identical to the data contained in the first five portions of the Enrolled Student Extract. Much of the computer program which is used for the first five portions of the Enrolled Student Extract is also used in the Prospect/Applicant Extract. The use of essentially the same COBOL code in two different programs facilitated the development of these two programs.

The content and format of the Enrolled Student and Prospect/Applicant Extracts are much different from those of the Course/Faculty Load Extract. The first two extracts produce a data matrix with rows which represent students (enrolled, applicant, or prospective) and columns which represent variables. The Course/Faculty Load Extract produces a data matrix with rows which represent courses (or sections of courses) and columns which represent variables.

The Course/Faculty Load Extract contains two major parts (see Table 4). The first, or instructor information part, contains the information about the person(s) responsible for teaching the course. This includes the instructor's name, and his/her home department, and division. The second, or course information part of the extract, contains identification information about the course, the department offering the course, enrollment in the course (section), where the course meets, and when the course meets.

The three extract programs were written in COBOL by a competent, experienced computer programmer. The programs were not an easy programming task. Each program took approximately two weeks to write. The main difficulty in writing the extract programs was not in the development of the code itself, but in determining which data elements were required, which file a desired element was located in, and in developing the link-paths needed to be able to access the data.

The validation of the extract programs and the data which they extract from the ISIS database is an important and time-consuming part of the process of developing an institutional research database. Fortunately, we maintain a test system with a test database which contains about five percent as much data as does our "live" system. Initially, the extract programs were run using the test database as the files from which to extract data. The data which were extracted from the test data files were then compared to the known content of these files. Finally, the extract programs were run using the "live" database files. The results of these runs were spot-checked and the number of records extracted were compared to the number of records which several of the batch programs indicated were present within the system.

Using Extract Programs

Once the extract programs were developed and validated, a schedule was developed for their use. The Course/Faculty Load Extract extracts data which is generated in ISIS by a batch program which "rolls" census day (12th class day) enrollment data into particular data elements. The extract is, therefore, scheduled to be run the day following the "roll". This extract is designed to be run for a designated semester. When the program is submitted, it extracts data for the semester which is designated on the control card for the program. Our ISIS is designed so that historical data can be kept in the database. We are now in our eighth semester of the use of our ISIS and the Course/Faculty Load Extract Program can be used to extract data for the current or any of the previous seven semesters. A copy of the Course/Faculty Load Extract data for each of the eight semesters is now kept in our vault. Should we now decide to go back into our ISIS to extract the data using a different approach, we could.

The Prospect/Applicant Extract is run several times each semester to extract data on prospective students. Trinity University is an institution which is very interested in tracking the receipt of applications and the quality of the persons who make application. For 40 weeks of each year the Prospect/Applicant Extract is run to extract data on applicants. The extract is run at the close of the work day each Friday, and the data on the quality and the number of applicants is published on Monday.

The Prospect/Applicant Extract program is a flexible one. The program permits data to be extracted for graduate and/or undergraduate students. Also, the program is designed to extract data for those persons who have applied for admission in one or any of a number of semesters. This program can be used to extract data on persons who have applied for admission in past semesters. The capability of being able to extract data from the current and from the past year(s) provides a great deal of research capability.

The Enrolled Student Extract program is just as flexible as are the other two extract programs. This program will permit data to be extracted for graduate and/or undergraduate students who are/were enrolled in any semester. Also, the number of credit hours for which a student was/is/will be (preregistered) registered can be determined. At present, we can only extract registered credit hours for nine semesters (8 past, 1 future) because that is all we presently have in our system. The extract program is designed so that it will eventually be able to retrieve data for up to 20 semesters for each student.

When data are extracted for semesters prior to the current one, the cumulative data elements in the extract reflect values for the current semester and not for the semester for which the data are extracted. Most of these differences can be adjusted by subtraction prior to an analysis of the data.

The three extract programs provide a great deal of research power to an investigator. With the structure of the ISIS, the researcher no longer needs to go from office to office gathering data but can, instead, obtain integrated data from a single source. Also, the data have already been validated by the individuals who put it into the system. Finally, longitudinal data are readily available and easily obtained.

Using the Extracted Data

Each of the extract programs produces a magnetic tape which contains the data that were extracted. Before beginning the data analysis, the person responsible for conducting institutional research must understand the data that he/she has on the magnetic tape. The data produced by each of the extracts can be viewed as being a series of rows and columns. These rows and columns constitute a data matrix. For two of the extracts, the matrices have rows which represent students (or prospective students), and columns which represent variables. In analyzing the data, an investigator examines one or more of the variables (columns) for all or for some subset of the students (rows). This means that an investigator must have a computer which will permit him/her to examine variables and to select all or some subset of the students. To "examine" variables implies the use of one or more of several investigative techniques. First, examination may involve simply describing the distribution of responses on a particular variable. This could be as simple as calculating the measures of central tendency and dispersio and producing a simple histogram. Second, examination may involve producing a cross-tabulation of two or more variables, producing a breakdown of one variable given one or more other variables, or producing a coefficient which indicates the strength or the amount of relationship between two or more variables.

The process of examining variables is typically done in combination with choosing some subset of the students on whom the data were gathered. For example, an investigator might be interested in comparing the academic performance and aptitude of male and female students. To do this, he/she could select to compare the GPA and SAT scores of the male and female students. To complete the analysis, the investigator needs to be able to select out the scores of all the male students and to do the necessary calculations on their variables (scores). Once this is completed, he/she must then do the same thing for the scores of the female students. It is combinations of these selection and analysis processes that an institutional researcher carries out as he/she does his/her work.

Conceptualizing a set of data as a matrix can facilitate the process of conducting research since this is the way in which most computer programs carry out their work. To date, there are no small (micro) computers which are capable of analyzing in a reasonable amount of time the data produced by the extract program. A large main frame is therefore required to read the tape and analyze the data.

There are a number of commercially available software packages which can be used to analyze data on a large main frame. The two most popular ones are SPSS and SAS. Neither of these statistical packages is very "user friendly", but both of them contain commands which are very "powerful". Power in this instance means that there are statements or commands in each of these statistical packages that an investigator can use which make the computer do a lot of work for him/her and do not require that the investigator do a great deal of work or have a great deal of knowledge of computers in order to get the computer to accomplish the work.

Using SPSS, an investigator can use one or more SELECT IF statements to identify and select almost any subset of a student body. These statements are very easy to learn and to use. Once the subset of the student body is identified and selected using SELECT IF statements, then statements such as FREQUENCIES, CROSSTABS, BREAKDOWN, CORRELATION, etc can be used to analyze the data. An institutional researcher who is new to computers may need some assistance in formatting data obtained by an extract program and in the initial preparation of a data deck. However, after having obtained some initial assistance, there is no reason why he/she cannot be conducting analyses on his/her own in a few days.

It is difficult to envision an effective director of institutional research who does not have a first- hand knowledge of the data which are collected on a campus, how the data are collected, how the data are formatted, and how the data can be analyzed. Even if this individual does not conduct his/her own analyses, he should have a knowledge of the characteristics of the data in order to effectively direct those individuals who do the work for him/her. As extracted data become more common, computer systems become more available, and institutional researchers become more knowledgeable, institutional researchers will be able to make even larger contributions to the administration of their institutions.

IS THERE LIFE AFTER DEATH OF YOUR SOFTWARE VENDOR?

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ABSTRACT

How does an institution recover from the shock of losing its Information System vendor? Should there be a period of mourning before a decision is made to "go it alone" or seek a new partner? What about the children (users) who have grown dependent upon both partners; how does one prepare them for the changes which are certain to occur? Institutions which have built their Management Information Systems around turnkey packages should be prepared for possible changes in the client/vendor relationship. The vendor could literally go out of business or the vendor could be acquired. Changes in vendor management will affect your institution. Do you have to lose control when you acquire a turnkey package? What legal advice should you seek and when?

The presentation will chronicle the events associated with the demise of a software firm (AXXESS, Inc.) which supplied a software package to institutions of higher education. Some of the topics addressed include:

1. What crises presented themselves?
2. What were the legal ramifications? Were there differences in institutional interpretation?
3. How did the various institutions react to the situation; individually and as a group?
4. How did the various events impact college operations?
5. What was the role of third parties?
6. What were the interests of other hardware and software vendors?
7. What was learned that might be of some assistance to other institutions who are currently utilizing third party software or are contemplating acquiring such software?

Some important considerations include:

- a. contents of contracts and the existence of multiple versions,
- b. software escrow and user responsibility for acquiring current versions of software,
- c. documentation and training,
- d. developing a communications network (oral and written),
- e. the impact of court deliberations on college operations at different points of time,
- f. liability for prior licensing agreements, and
- g. the realities of exchanging and developing software.

"I hate to be the bearer of bad news, but have you heard that AXXESS Information Systems has closed its doors?" These words shocked MIS Directors at twenty-nine institutions on or about April 28, 1983. Some received word from other users, some heard the news from software vendors who competed with AXXESS, none heard from AXXESS. A few received word through the grapevine from AXXESS employees. Over the next several days varying degrees of panic began to set in. A few institutions had installed all of the AIMS software package; most were in various stages of installation ranging from receipt of tapes to several modules in place. AXXESS had contracts with the institutions to provide software, installation, user and administrative training and, in most institutions, the hardware and operating system. The "womb to tomb" turnkey package philosophy had been bought into by these institutions and now they faced a different "tomb."

The death or demise of a software vendor brings no small amount of anxiety into the heart of an institution which has decided to control its flow of information with a turnkey package. Most institutions decided to go with a turnkey package for similar reasons. Some common considerations include:

1. An ability to achieve performance in a timely and cost efficient manner.
2. The sharing of overhead with other similar institutions in designing, building and maintaining a software package.
3. An ability to meet 90% of the information needs for much less cost than would be required to "do it alone." (Some refer to this concept as the "90/10 Rule," 90% of need for 10% cost.)
4. The ability to achieve superior design by utilizing the services of many professionals who have done the analysis and design based on the functional needs of an institution, not on the political and personnel whims of the institution.
5. The sharing of future enhancements of the package with other institutions. (Enhancements may include those changes which are required by changes in laws, regulations or changes in the hardware or operating system.)
6. An ability to share ideas and training with other users. (Usually this takes the form of a strong user group.)

The users of the AIMS package (AIMS is the name of the turnkey package sold by AXXESS) had formed a user group and had already held several meetings prior to the demise of AXXESS. This group (AUG) moved quickly to comfort and inform users. A meeting was called for users to gather at Bank Street College in New York City on May 3 & 4, 1983. The purpose of this meeting was to pool information and ideas.

The Bank Street meeting began with fears and concerns being expressed. Representatives from the institutions had many "hidden agendas" that they wished to pursue. As the meeting moved forward, these items of concern came to the table of discussion. The following list characterizes those concerns voiced at the meeting:

Legal Concerns

1. What really is the status of AXXESS; has bankruptcy been filed; if so, under which chapter of the regulations?
2. What is the legal status of AIMS; who owns it?
3. Who are the principle characters from the bank, investors, owners?
4. What are the user implications? What do we owe, to whom? Can we continue to use the software; did we really buy a perpetual license?
5. Who owns the client unique modifications, the institution or AXXESS?
6. Can we share information about the software with each other?

Software Concerns

1. What bugs are common to all users (current and future)?
2. What client unique modifications exist?
3. What is the current status of AIMS Revision 2.1, 3.0?
4. What is the current status of AIMS and its ability to run on the most current revision of the operating system?
5. What is the status of future product design proposals?

After many hours of conversation (in some cases simply the venting of feelings), the following outcomes were established:

1. The users' group, AUG, would organize more formally with the following officers elected:

   President: John Sutton, St. Norbert's College
   Vice President: Carol Lennox, Mills College
   Secretary: Michael Zastrocky, Regis College
   Treasurer: Charles Jackson, Hampshire College

The officers were also organized as an executive committee to make short-term decisions for the group and to communicate information to all users.

2. A pool of money would be established from an emergency dues supplement to hire legal counsel and a technical consultant.

3. Support alternatives ranging from groups of ex-AXXESS employees, to the users' group to other vendors were listed and assigned to members for possible consideration.

4. A meeting was set for June 24-26 at Mills College.

It is important to note that twenty-four institutions sent forty-two people to the Bank Street meeting.

The Executive Committee received emergency funds (the additional dues) from the following institutions:

Rice University
Hampshire College
Bates College
Skidmore College
Drew University
LaRoche College
Bank Street College
Bentley College
University of St. Thomas
Davidson College
Morehead State University
Gettysburg College
Morningside College
Swarthmore College
Wellesley College
St. Norbert's College
The Art Institute of Chicago
Columbia College
Connecticut College
Eckerd College
Mills College
Katherine Gibbs School
Regis College
College of Insurance
Hawaii Loa College
Bryn Mawr College
Adelphi University

Mr. James Higgins was hired as legal counsel and Mr. Peter Oliva was hired as a consultant to pull together information concerning resources available (or potentially available) to AUG. Mr. Higgins began immediately to assess the legal "what ifs." His background as legal counsel for Drew University in their contract negotiations with AXXESS allowed him the opportunity to begin with a high degree of background in the problem. Mr. Oliva was hired to assess what were the current strengths within the user group; who from member institutions could serve as resources to other institutions. Mr. Oliva's background as MIS Director at Drew University, as well as his role in another users' group that experienced the demise of its vendor, brought much needed background to AUG.

During the next several months legal information began to surface. AXXESS had indeed been forced into chapter 7 of the bankruptcy code by former AXXESS employees' claims. Ownership issues began to filter through and information from the user community revealed much strength and many possible opportunities for AUG.

The June 24-26 meeting at Mills College was very different from the Bank Street meeting. Confidence replaced fear and anger, creativity on potential solutions to the problems abounded. Legal counsel provided legal evaluation and replaced MIS Directors who at Bank Street had explored legal "what ifs." A true inventory of AUG was available and overall a tight organization existed and provided an interesting agenda. The following outcomes were achieved at this meeting:

1. Legal counsel provided an indepth assessment of what had happened and what legal implications existed.
2. Potential external support groups made formal presentations to the group.
3. A formal set of Bylaws was approved.
4. Workshops related to the Financial Aid, Fiscal and Student Records modules were held.
5. A game plan was outlined and approved.
6. The Executive Committee (officers) were appointed as temporary officers of a for-profit corporation to be formed in the event AUG decided to attempt to purchase the software.
7. Another meeting was set for fall, 1983.

During the next several months legal counsel and the Executive Committee met frequently via telephone links and in person to review proposals and explore the strategy of forming the for-profit corporation idea.

In July, 1983, Byytebaack, Inc. was formed as a for-profit corporation to attempt to purchase the software as the final asset from the bank. All AUG institutions were given the opportunity to purchase three shares of stock in Byytebaack, Inc. The following institutions chose to do so:

Adelphi University
Art Institute of Chicago
Bates College
Bentley College
Bryn Mawr College
College of Insurance
Connecticut College
Davidson College
Drew University
Eckerd College
Gettysburg College
Hampshire College
Hawaii Loa College
Katherine Gibbs School
Mills College
Morehead State University
Morningside College
Regis Educational Corp.
Rice University
St. Norbert College
Skidmore College
Swarthmore College
University of St. Thomas

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Morehead State University
Morningside College
Regis Educational Corp.
Rice University
St. Norbert College
Skidmore College
Swarthmore College
University of St. Thomas

On August 22, 1983 Byytebaack successfully acquired the ownership of the AIMS package and other software previously owned by AXXESS. A shareholders' meeting was scheduled for September, 1983 in Chicago to elect a Board of Directors and Corporate Officers. A tentative agenda for the meeting was established by the interim board.

Following the election of the members of the board in Chicago, the shareholders meeting was adjourned in order that the board might have a meeting, elect officers, and proceed with the business at hand. The board was convened by Chairman John Sutton, the Director of Computer Services at St. Norbert College. Officers that were elected at that meeting were the President, Dr. Paul J. Plourde, Vice President for Information Services at Bentley College; the Vice President, Dr. Scott A. MacDonald, Executive Vice President at Drew University; the Secretary, Dr. Salvatore Ciolino, Associate Dean of Educational Services at Gettysburg College; and the Treasurer, Kenneth H. Smits, Controller at St. Norbert College.

The first item of business after reconvening the shareholders was to resolve any problems with the licensing agreement. The reason that this was required was the legal action brought by Microdata which was based on the fact that AXXESS had not paid Microdata the license fee for some of the AIMS users. The primary objective was to grant a blanket license to all shareholders to use and modify the software and documentation and to sell or exchange modifications made at a given institution with any other member of ByyteBaack. Other provisions of the licensing agreement were as follows:

1. Enter into cooperative efforts with other licensees to maintain, enhance or modify the software or documentation,
2. In the event of equipment malfunction, the software could be used on other equipment temporarily,
3. The right to copy for archival purposes,
4. Holds licensor harmless of use by licensee which causes ByyteBaack to pay a royalty to Microdata,
5. Disclaims any warranties on software or documentation, and
6. Specifies that neither the agreement, nor any of the rights hereunder, shall be assigned, sublet, conveyed, or transferred by licensee.

The next step was to identify the short to mid-term objectives that the company wished to accomplish and these were fodder for considerable discussion. What follows is a reasonable approximation of the objectives that we have focused on during the past four months:

1. Of utmost concern was to complete the acquisition of the software and to resolve any and all licensing problems with Microdata or other third parties.

2. It was crucial that we acquire the physical tapes and inventory the software.

3. Since one of the prime objectives of incorporating was for all shareholders to acquire the current version of the software, which was either under development or being distributed by AXXESS when they went bankrupt, we viewed the distribution of the software as crucial.

4. We wanted to create a central repository for the software on a system in order that we might evaluate the different versions that either had been released or were under development. The problem here is that there were different versions distributed to different users and we felt it was important for the future portability and exchangeability of software that we attempt to develop a common version.

5. To this end, we wanted to either contract for development of a new version of the software or develop a consortium of current users who would develop various modules.

6. We wanted to explore the possibility of passing the title to the software or develop a working relationship with a third party for development and/or marketing.

7. We felt that it was important to improve the documentation that existed and develop such things as installation guides that could be utilized by shareholders who wished to install some of the new versions of the software. It is important to note at this juncture that one of the provisions of the licensing agreement is that shareholders who had not contracted for specific modules with AXXESS had now acquired all modules by virtue of the licensing agreement. Thus, we expected a number of institutions to install modules that they heretofore had not utilized.

Following the Chicago meeting, we were wary of what could have been a natural letdown as one usually expects after attending a national meeting or conference such as this CAUSE conference, but such was not to be the case. Progress towards achieving our goals continued even though all of these efforts were being conducted by volunteer officers of the corporation. The one exception to this was the continuing relationship with the attorney who guided us through the incorporation and subsequent deliberations with a number of companies with whom we have either developed associations or were trying to resolve licensing agreements.

In order to maintain the momentum of the Chicago meeting, we decided to have the first official annual meeting of the corporation in Houston in November. We felt that this would give us a target to achieve our short-range objectives and provide an opportunity to reconvene and set some longer term objectives. The report to the shareholders at this meeting was quite encouraging since we did finalize the acquisition of the software and resolve the licensing agreement with Microdata which will terminate in April of 1985.

The revised licensing agreement was sent out and was signed by a number of schools. Most of the ones who had not yet returned the agreement were available in the flesh to sign the agreement at the Houston meeting. The software in the form of some 32 tapes acquired from the trustee was transported from the bank to Drew University and subsequently to Bentley College. This allowed us to create what is now called the BYYTEBAACK system, and would provide a site for the developmental activities that were required as a next step.

At the same time, negotiations were taking place and an agreement was reached with The Watchung Software Group, Inc. This is a group of technical individuals who were former AXXESS employees who incorporated to provide support for AIMS users. Their first task was to inventory the software and identify which programs (1) did not compile, (b) had bugs in them, (c) had screen format errors, (d) had report problems, and (e) needed cosmetic change. We were also interested in the effort required to produce either a vanilla version of the software or an upgraded version which would include such items as the multiple semester capability, which was in the process of being developed at AXXESS.

A preliminary report of the findings of Watchung was presented to the board at Houston and the board decided to proceed to the next step, which was to contract with Watchung to resolve all difficulties with the software short of making the cosmetic changes, which would be addressed later. Subsequently, a contract was negotiated with Watchung to develop the vanilla version of the software for distribution to all licensees by April 1, 1984.

Negotiations were started with several firms (among them several Big-8 firms and a few software vendors) to ascertain the level of interest in either developing and marketing or simply marketing a version of this software. To date, those negotiations have been most fruitful and the board will convene in early 1984 to make a determination as regards which of the companies we wish to either work with or wish to be associated with.

Since one of our concerns was documentation, a number of initiatives were taken to improve the state of the current documentation. A project was started by Drew University to document the accounts payable system, and this was spearheaded by another former AXXESS employee, Dave Douglass. The resultant documentation was acquired by ByyteBaack for distribution to its shareholders. In addition, ByyteBaack acquired the rights to documentation that was also prepared by Dave Douglass when he offered seminars for AIMS users during the summer of 1983. This is currently being upgraded and will soon be distributed to licensees.

It is significant that during this entire period the level of cooperation and exchange of ideas, documentation and software amongst users of AIMS has increased beyond that which existed when AXXESS was still functioning as an organization. It is also notable that the users group survived as an organization, as well as ByyteBaack, and had its bi-yearly meeting in Houston in November, as well as the previous meeting in Oakland, and the next meeting has been scheduled for Florida in May of 1984.

This is not to suggest that the AIMS users have proceeded into the abyss without difficulty since a number of problems have continued to plague us. The most significant of these problems has been the continued legal hassles with the trustee since they have seen fit to bring legal action against all users of AIMS for the accounts that were receivable at the time of AXXESS' demise.

Another potential problem was acquiring support from knowledgeable individuals who either worked for AXXESS or had developed sufficient knowledge of the system to assist users. This has been partially resolved by the establishment of several small companies and the redirection of certain other companies who have been of some assistance to the users. Some of these firms include Archon Computer Solutions, The Computer Assistant Group, Information Solutions, and The Watchung Software Group.

Similarly, ByyteBaack has continued to have legal confrontations with companies who purport to market an AIMS lookalike system. This has been offset by the good fortune of having also acquired a number of financial and distribution oriented packages which industrial firms seem bent on acquiring. Thus, we proceed into the future recognizing full well that we will have to develop a corporate game-plan which, undoubtedly, will include hiring a full-time executive director to act as an intermediary between the shareholders and whichever company is licensed to develop and/or market the software.

From all of this, what should a college or university that is contemplating acquiring such software learn from the experience of the AIMS users?

First and foremost is the fact that this comedy of errors reinforces the need to thoroughly research the viability of the company that is providing the software. A point which surfaces and one which few of us were aware of is the necessity to ascertain what prior claims exist on the software. This is the equivalent of a title search.

A related legal issue is the necessity to negotiate an iron-clad contract. There were as many different contracts as there were colleges utilizing the system and, for the most part, none of these were satisfactory.

Of equal importance are the questions of the status of the documentation of the system and the ability of individuals (technical writers) who are not familiar with the system to document the system. A corollary to this question is whether the documentation and the software is stored in escrow by the vendor by people who have acquired licenses in the event that the company should fail. The unavailability of a system flowchart that shows the interrelationships of the various modules and their corresponding files continues to plague the users of AIMS. Although we are currently making progress to resolving the issue, the availability of a system made to facilitate user comprehension should be central to any software evaluation.

Another technical and equally important question is the composition and source of the software and tools that were utilized to create the system.

There are a number of companies currently marketing software where they have modified the operating system or where they have used a hybrid language, and the latter was certainly the case with the AIMS system.

The cornerstone of the system relies on the use of Information which is a derivation of the Pick system and software, and this was previously supplied by dealers of Prime hardware. Of more import was the fact that Prime was not providing support for this set of tools and the system had been developed by a company called Devcom, Inc. Fortunately for the AIMS users, the Information system was acquired by Prime during 1982 from Devcom and the documentation and support for this system, which is the underlying structure of AIMS, is now a concern of Prime. This has helped immeasurably and has been a vital factor in the ability of the users to survive during this period.

As regards the application modules, it seems clear from our experience that the users have a responsibility to influence if not control the direction of the development of modules and the issuance of new releases. AXXESS modified the system at will and issued new releases without insuring that all users had copies. Furthermore, there were numerous different versions extant at any given time which will complicate the goal of getting current users converted to a vanilla version. From our perspective, this requires that people evaluating software examine the enhance procedure carefully, whether it is for a change approved by the users group or a change for an individual institution. The question is who and how will the many different versions of software be managed.

A final note is that this whole scenario stresses the importance of the users group. Even if one cannot get together to do legal battle against a company or a trustee, certainly there is merit in coming together to share ideas and cooperate, and it was good fortune that the users group was, indeed, functioning as well as it was when the death knell of AXXESS occurred.

TRACK V
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A Distributed
RESOURCE MANAGEMENT & RESEARCH INFORMATION SYSTEM
for Student Services

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This paper will describe the generic design features, content, and multipurpose uses of a network of administratively independent but technically integratable "relational" information systems across student services units at The University of Michigan. Using a variety of DBMS "relational" data base management software on micros, minis, and mainframes, the Student Services Division has created a federation of user designed and developed information systems to serve (1) each unit's unique needs, and (2) the collective "corporate" information needs of this division in planning, resource management, and research. System Development Strategies include: (1) maximum user involvement and control, (2) user-friendly development tools, (3) file transfer capability, (4) generic data base design, (5) staff "retreading," and (6) distributed information resource management.

The University of Michigan is a large research oriented institution which promulgates organizational decentralization, autonomy and accountability. Operating effectively in that environment requires comprehensive, timely, and accurate information pinpointing resource utilization both within and across relatively autonomous units. Recognizing such information as an asset in the 80's, the Student Services Division at the University of Michigan has begun an effort to create its own distributed information resource management program designed to monitor services and support resource allocation and service effectiveness.

Headed by a Vice President, the 8 line units of the Student Services Division are responsible for providing direct service to the campus community in such areas as: counseling, career planning, student activities, housing, health care, and problem resolution through ombudsman services. In the style of the university, these units operate with significant managerial autonomy yet recognize their interdependence in grappling with campus-wide issues such as "stress", quality of campus life, and overlap of many service functions. In a era represented by scarce resources it is imperative that existing programs and services operate effectively and efficiently within and across units. Consequently there was a need to develop information systems within the Division which (1) supported unique needs in a particular unit and (2) simultaneously supported corporate assessment and planning.

Dynamic, non-redundant, flexible information systems specific to a particular unit's needs were desired to answer such questions as:

* Which services are being used by what type of student?
* When (days, hours) are particular services demanded?
* How efficient are the staff (providers) ?
* Are particular types of students "overusing" services?
* Could redistribution of resources improve effectiveness?
* Can we use service data as indices to monitor stress?

Similar questions were also germane for planning and conducting campus-wide research at the aggregate (or corporate) level.

The remainder of this paper will describe design principles, strategies, architecture and applications of a "federation" of information systems designed, built and maintained by several of the Student Service units to answer the previous questions. While many of these systems incorporate extensive applications, this paper will only focus upon the "Client/Provider" components of a few of the units. All units however have similar systems in place or in development.

As with information system development generally, the Student Services Division faced several constraints and made several assumptions in order to obtain these systems. Initially, the campus central data processing center could not: (1) develop cost-efficient systems rapidly, (2) provide expertise in micro or minicomputer technology, (3) support distributed processing apart from their central CPU. Student Services units could not: (1) politically or financially afford hiring new technical personnel, (2) adequately define all uses, users or information requirements needed, (3) offer much technical literacy on the part of existing staff within the individual units. Nevertheless, the desire and commitment to obtain and manage their own information systems maintained.

Realizing the constraints, the following assumptions were made:
* Student Services Units would have to chart their own course at least initially.
* Uses of the information systems would change with user sophistication and experience.
* New unanticipated data would need to be integrated into the system periodically.
* Hardware and software capabilities would probably be expanded in response to changing user needs.
* All this would probably occur at an accelerating rate and with limited resources.

The initial impetus in testing these assumptions came from the Health Services unit, followed in turn by Counseling Services, Ombudsman, and Career Planning and Placement. In order to control the contagion stage of the information systems maturation cycle without creating another data processing center, design principles and strategies guided the effort.

Possibly the most significant principle undergirding the development of the distributed system was the recognition that our most important investment was not in the technical tools (ie. hardware, software) but in our own **human capital.** That implied "retreading" existing staff rather than hiring new staff. It also underscored the fact that an individual's ability to become tool proficient is more important initially than the sophistication of the tool. This concept was analogous to skilled craftsmen and artists where the utility of the tool is subordinate to the proficiency and creativity of the tool user. Old tools in the hands of skilled users may be preferable to fancy new tools in the hands of novices. This principle was applicable across all levels of the organization thereby suggesting at least tool literacy for all who expected to engage in information creation, or utilization.

A second fundamental principle pursued across units was that of **"interchangeability of parts"**. In order to adequately underwrite our own development, it was important to have some assurance that hardware and files could be shared without retraining staff or reprogramming software. Familiarity with common CRTs, printers, operating systems, 4th generation software across users not only guaranteed possible interchangeable staffing patterns, but relieved anxieties in emergency staffing and facilitated establishment of peer support groups.

Strategies used to implement the "investment in human capital" principle, revolved around maximizing user involvement in design, development implementation, maintenance and subsequent control of the information system. In effect this meant creating the capacity and responsibility for information resource management within each unit. To do so quickly necessitated the acquisition of 4th generation software to be used on multiuser microcomputers which could be linked for file transfer to mainframes. Relational DBMS packages were chosen not only for their easy data base design and query, but also because the particular microcomputer DBMS software (ie. CONDOR) just happened to have syntax nearly identical to analogous mainframe DBMS (ie. MICRO) and very similar to the chosen prime minicomputer DBMS (ie.INFO). Peer support groups were also envisioned to encourage staff learning and foster a type of creative synergism in novel and creative uses of software.

The peer support strategy was intended both within and across units as well as for all administrative levels of the organization. The notion was that at least one individual in each unit should become proficient and subsequently train others in at least tool literacy. At the highest administrative levels (ie. unit directors) such proficiency really implies how to use information effectively rather than how to create information systems. At mid-level strata, such proficiency suggested skill at information resource management. This meant information system maintenance, file updates and revisions, query and hardware maintenance. Proficiency at the line level strata meant proficiency in at least one piece of software. People within each strata could eventually begin to rely upon one another for technical and emotional support even across student service units.

Supporting design strategies involved the expectation of building and relying upon a sequence of "working prototypes" within each unit rather than a "final system". Such a strategy implied beginning with low cost user controlled system to meet immediate needs and as staff gained experience with the tools and capabilities of the initial prototype, new applications, efficiencies and data expansion would follow. The capability of relational data base management to change, add, and relate data bases without major reprogramming was clearly favored over possibly more efficient but less flexible "canned applications". This was particularly important since staff would assume future responsibility for modifications.

Another important design strategy was to assure adequate technical redundancy to reduce the risk of data loss or unavailable tool backup. To some degree each subsequent "working prototype" within the unit could rely upon the previous prototype as a backup resource in emergencies. However, duplicate data bases were expected to be maintained on separate hardware and software (either in other units or on the central mainframe). Since each unit had a Z-80 CPU, either CP/M or MP/M operating system and 8 inch floppy drives, file transfer was straightforward. Direct file linkage between micros and the AMDAHL mainframe was available through an MC/P protocol developed on campus. This feature enabled the corporate data bases to be maintained on the mainframe and simultaneously serve as backup to individual units.

The development of the first system began in 1981 in the Health Services unit. The "patient/provider" data base eventually became the basis for a more generic architecture entitled the "client/provider" transaction system. While the data definitions and number of data elements varied across units, both a set of core data elements and a generic data base schema were used in subsequent unit specific client/provider systems. Standardizing the core data elements (ie. client ID, residence, referral agency, university affiliation, etc.) was necessary to link (ie. relate) files across units. The generic architecture was used to establish a common frame of reference for measuring service and professional activity within the division both for resource management and research into campus issues.

As depicted in the diagram, the primary components of the "client/provider" information system are the: client information, provider information, characteristics of the transaction, and the taxonomy of service provided. Generic data elements measuring each of these components are illustrated at the lower right. Of course the documents and data definitions for these elements vary with the service agency. For example, the data element "service type" may be a table of counseling activities, or resident advisor roles, or MD diagnoses. Transaction mode may be categories such as: one-to-one, group sessions, telephone calls, or distributing literature. Wherever possible, common data definitions have been used across units.

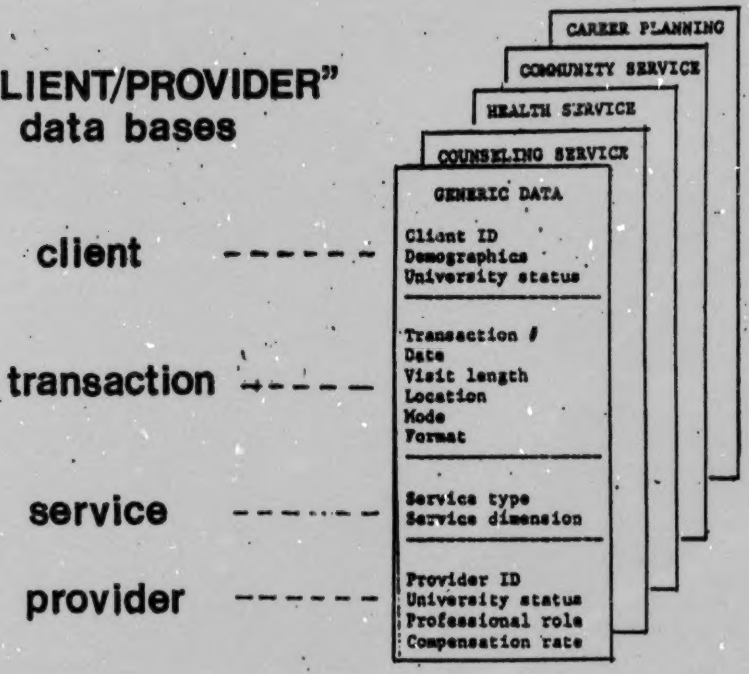
Because each unit was using a relational DBMS many data bases were created to contain information relating to various aspects of the unit's particular service efforts. However, most of these data bases were eventually related (ie. joined, compared, or combined) with records from 4 primary **"client/provider"** data bases as depicted in the diagram. Examples of such data bases include: service outcomes, client history, lab tests, procedures used, performance effectiveness measures of staff, staff resumes, and other measures of the client, the provider, or the nature and scope of the transaction between them.

INFORMATION SYSTEM COMPONENTS

A client transacts a service with a service provider:

A (student) (talks) about (emotional problems) with a (counselor)
A (patient) is (treated) for a (diagnosed illness) with a (doctor)
A (resident) (discusses) (roommate conflicts) with an (RA).

"CLIENT/PROVIDER" data bases



client
transaction
service
provider

CAREER PLANNING
COMMUNITY SERVICE
HEALTH SERVICE
COUNSELING SERVICE
GENERIC DATA

Client ID
Demographics
University status

Transaction #
Date
Visit length
Location
Mode
Format

Service type
Service dimension

Provider ID
University status
Professional role
Compensation rate

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Since the initial system was created in 1981, each direct service unit is using or in the process of creating their own working prototype "client/provider" based system. Most units are using CONDOR relational DBMS under MP/M on a Z-80 CPU (typically an ALTOS with between 10 and 40 megabytes). All units have the capability to transfer their data bases to the AMDAHL research mainframe and query them from the MICRO DBMS which has syntax analogous to CONDOR. In the interim, Health Services has moved to a PRIME minicomputer and INFO DBMS in order to integrate their "client/provider" system with appointment scheduling software specifically purchased for a health care facility. The current array of technology tools is displayed for the various units in the diagram which follows:

	HEALTH SERVICE	COUNSELING SERVICE	CAREER PLANNING & PLACEMENT	COMMUNITY SERVICE	OMBUDSMAN ORIENTATION	STUDENT UNION	HOUSING	PROGRAM ANALYSIS	VICE PRESIDENT'S OFFICE
HARDWARE									
Mainframes:									
IBM							●	●	
AMDAHL	●	●	●		●			●	
Minis:									
WANG							●		
PRIME	●								
Micros:									
HINET						●			
ALTOS	●	●		●	●		●	●	●
ALSPA	●				●			●	
OTRONA								●	●
TRS-80			●						
IBM-PC						●			
SOFTWARE									
DBMS:									
IMS, RAMIS							●	●	
INFO	●								
MICRO	●	●	●		●	●		●	
CONDOR	●	●	●		●	●	●	●	●
DBASE II						●		●	
LOTUS						●			
PROFILE II				●					
Spread Sheets:									
Visicalc			●					●	●
Supercalc	●	●		●	●	●	●	●	●
Calcstar								●	●
Multiplan								●	
Word Processing:									
Wang							●		
WordStar	●	●		●	●	●	●	●	●
Scriptsit			●						

Clearly the primary benefits of such a distributed information system network, accrue to the units themselves. Given the ease of using relational DBMS and integrating auxiliary data bases over time, several resource management applications have emerged. Staff within the service units access the system for comparative data necessary to develop their own staff performance benchmarks. Different standards have been created for different categories of service providers by those service providers themselves. Departures in methods of providing service or expected transaction lengths can be very beneficial to increasing both productivity and effectiveness. The efficiency of facility utilization through time series analysis of client demand is often improved, resulting in more effective staff scheduling. Heavy users and "abusers" of services can be identified and dealt with more personally. Particular cohorts of clients (possibly clustered by service useage patterns) can be studied over time and compared for example to the behavior of matched samples of non-clients. All of these uses are available as part of the routine record keeping procedures but because they are computer-based, analyses can be conducted for any set of clients, transactions, providers, combinations of the latter, and for any day, month, year, etc.

From a corporate perspective, data bases consolidated across units and analyzed at the divisional level provide a rich planning and research resource. Comparative analysis of service mix across units suggests a patterning of client markets which may be related to geography, service quality, visibility or other factors. Such information systems enable costs per client comparisons across service categories and support the creation of program budgeting by service area rather than by unit. Using these data bases it is possible to determine whether there is really only a small percentage of the potential campus community using services time after time, versus a large percentage of the population using services modestly. Such analyses contribute to research related to campus epidemiology.

In addition to offering direct service for immediate problems, the Student Services Division has some responsibility to become proactive in improving environmental conditions which unnecessarily aggravate student development. Using a multivariate analytic tool such as cluster analysis on student characteristics enables an institution to develop empirical "taxonomies" or "typologies" of the student body. Students with similar profiles of health habits (from Health Services data bases), and illness patterns (from various units data bases) could be grouped into homogeneous clusters for research into correlates of illness on this campus. Predictive inferences might subsequently suggest preventative programs or self help programs to reduce illness differentially among the clusters. The ability of the collective federation of information systems to provide empirically based clusters of students "at risk" or "under extreme stress" could have significant impact upon the success of those students in avoiding or reducing negative consequences. Similar scenarios could be described for other services such as career planning, counseling, and so forth.

The real tools in using such a distributed resource management and research information system are the end users themselves and their own ingenuity in creating and applying information. There appears to be a learning effect which occurs when individuals begin to feel comfortable with the micro-computer and userfriendly software. It seems as if the ease with which query can be made speeds up the thought processes which "relate one thing to another". In a manner similar to "well, if it can do this, then why can't I also do....and so forth". The growth in mental productivity from such experience in no small investment. We hope that such efforts will create a synergistic effect among staff and contribute in some way to revitalizing the work setting. At the very least we have evidence that particular individuals in the human services field do in fact become more productive and valuable as a result of these efforts. With adequate peer support we expect that trend to proliferate across the division.

VIDEOTEX: A CAMPUS APPLICATION

by

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and

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Videotex is a technology vehicle designed for the delivery of home information services. The hallmark of a videotex system is its simplicity from the point of view of the user. In this case, there are two groups of users; those who provide information to the system, and those who retrieve that information. This simplicity makes videotex an ideal medium for the dissemination of information on a university campus where there are large numbers of both information providers and information seekers. A videotex system, once installed, can be operated without intervention by a technical staff (except in the case of system failure) and could, therefore, be used for a campus-wide bulletin board service with two-way communication capability.

Clemson University has developed an on-campus videotex system which, in its pilot stage, was used in a one-way bulletin board application. This is now being expanded to provide two-way communications so that the information data base can be queried using simple commands from a keypad. The project has aroused widespread interest both on and off campus, and ideas for additional applications are constantly being received. It would appear that there is a great need for a computerized data base, access to which requires no knowledge of computing on the part of the user. Videotex appears to provide such a facility.

VIDEOTEX - A CAMPUS APPLICATION

You may or may not have heard of videotex, but if you have not you undoubtably soon will. Videotex is a new concept in interactive computing services which has to date generated an extraordinary amount of light and heat and very little profit. Despite this lack of return, governments and corporations are counting on a great future for videotex, and are investing in it in a correspondingly grandiose manner.

What then is videotex? Videotex, like word processing, defies a strict definition, but basically refers to a two-way interactive service which is capable of displaying pages of text and graphics on the screen of a modified television set. An alternative name, with less universal acceptance, is viewdata. To confuse the issue somewhat, a more restricted type of service, teletext, is sometimes loosely included under the videotex umbrella. Teletext, however, is a one-way broadcast information service in which pages of information are continuously broadcast and can be selected on the screen of a modified television set by means of a keypad.

The ideas for videotex and teletext originated in England in the early 1970's, videotex with the British Post Office, and teletext with the BBC. The Post Office, which in Britain also had responsibility for the nation's telephone system, was experimenting with a system called Viewphone (comparable to AT&T's Picturephone).

The project was not successful because of the tremendous data transmission requirements of the video component. However, experiments were conducted on using the Viewphone to receive transmitted text, and from this came the concept of using a modified TV set in place of the Viewphone. A test service was provided in 1978 and the first full-fledged public service, Prestel, came into being in 1979.

In a videotex system the information which is to be made available to the users of the system is stored by information providers on a computer system at a service center. The information is stored in pages, a page being one screen of transmitted text, and the information provider pays the service center operator for the privilege of storing the information. A user of the system, a residential customer let us say, can connect his modified TV set to the service center computer via the phone line by dialing the center and using an acoustical coupler. The modified TV set is a simple dial-up terminal.

What is new about videotex?

The following is not new:

1. On-line systems
2. Dial-up access
3. Color graphics
4. Large number of on-line users

The following are new:

1. Cheap user hardware
2. Compact, standard text and graphics protocol
3. Standard, easy-to-use user interface
4. Public access in public places

Why is videotex generating such interest among major profit-oriented companies?

The attraction of videotex to those who originally conceived it was that it provided a means to cheaply put a computer in every home, and those computers could be used to distribute and receive information, purchase products from on-line catalogs, play games, and use up spare capacity on the telephone lines.

The original dream for videotex, then, was that it would be cheap, cheap enough for use in a mass consumer market, and that it would be used in the home.

The type of information suitable for a videotex system could be anything from news and weather to video games, from banking services to home shopping. After logging onto the system, which can be done by physically dialing the service center and utilizing an acoustical coupler, or preferably by using a modified TV with an autodial feature, the user can strike a single key on the keypad to bring up the basic index of information on the system. The index gives instructions on which page number to key in order to home in on the required information. It usually takes no more than three or four levels of index to get to the desired piece of information.

In the case of home shopping, the basic index would indicate the page for home shopping. This page in turn might indicate the pages for various broad categories of merchandise, and so on until the description of the particular item of interest is found. The item could be ordered and charged to the user's account by depressing the appropriate keys on the keypad.

While the idea sounds good, market trials do not indicate an overwhelming consumer demand. Three major trials of public videotex systems are particularly noteworthy. The first public service was Prestel. From the beginning, business useage exceeded home usage. Although the service is still provided, it has never attracted the subscriber base that its designers intended.

Vista is a joint service of the Canadian government and Canadian Bell. Support has now been withdrawn and the service will soon terminate.

Viewtron is a joint venture between AT&T Information Systems and Knight-Ridder. It is a test service being offered in the Coral Gables area of Florida. So far, no significant data is available on acceptance of the system.

So, in the absence of an obvious market for videotex services, we come back again to the question "Why Videotex?."

The reason that AT&T, IBM, DEC, Knight-Ridder, Time Inc., Dow Jones, and all the other videotex players are involved in videotex is the potential for huge profit. The idea of home services via some easy-to-use medium such as videotex is so good that it is worth a substantial investment. And even if the chance of success is small, no major company can afford even the slightest chance that a competitor could possibly wrap up the home consumer market.

While the emphasis in the U.S. is on home services - banking, library services, shopping, and the like - non-consumer services dominate foreign markets. Many of these government-sponsored videotex projects are extremely large, holding out the prospect of correspondingly large profits.

In France consumer banking and shopping services are being provided by use of a Smartcard, a credit card sized card with an embedded microprocessor to hold cardholder personal and financial data which can be read by special card readers. A major test is under way to offer telephone directory information via videotex.

In Germany the PTT has signed a major contract with IBM for the latter to develop a nationwide public videotex system. The project is behind schedule but it represents a major commitment to videotex on the part of the German government. It also represents a major commitment on the part of IBM. IBM is also marketing a Prestel-compatible system which runs on the Series I.

One of the reasons videotex is being heavily promoted is that it offers the opportunity to impose standards on public-access information systems. Governments, of course, love standards. The European governments, in particular, are actively promoting their own versions of videotex as a standard hoping to gain a marketing edge for domestic industry.

With governments involved there is the potential for huge profits. But governments are fickle and so no-one is prepared to make a bold push to develop public access systems on their own account.

People making money out of videotex are the sellers of hardware and software, consultants, and conference organizers. Information providers are not making money. Success for public-access videotex systems in the U.S. depends on the ability of the information providers to make money. AT&T is convinced that advertising is the key to making money with videotex systems. Their Viewtron field trial makes heavy use of graphics and is oriented towards revenue-generating information, particularly related to home shopping.

That, briefly, is a description of what videotex is and how it is envisioned that it will affect the general consumer. But why is Clemson University interested in videotex, and what has the University been able to accomplish in this area?

What are the biggest problems facing the management of a university computer center? Money and staff. We need money to keep our equipment up to date, and we need to find ways to keep competent employees. One way in which we can address both issues is to obtain funded research and development contracts which will provided funding for equipment and at the same time give staff members the opportunity to work on interesting projects which they would not be able to do in industry.

In casting around for suitable projects we came across videotex and recognized that this was a natural area of interest for a university. We are, after all, in the information business.

A good portion of the information with which we deal is in the form of all those calendars, directories, and bulletins with which we blanket our campuses. What does it cost to produce that information, and, having produced it, what are the distribution costs? Probably no institution has a good idea, other than that they are extremely high, and getting higher. No matter how good our intentions, the amount of paper we shuffle seems to increase in volume, and nothing we do seems to slow it down.

Could videotex be the answer to this problem of an ever-increasing administrative paperwork load? The answer was and still is by no means clear, but the problem is so severe, and the potential of videotex sufficiently evident, that it appeared a good case for a videotex research and development project could be made.

Perhaps more than other organizations, universities have had high expectations for computers in administrative ares, only to find that the anticipated cost savings never materialized. Videotex may possibly be the exception. The applications of videotex in the university are endless.

Course catalogs, campus maps, calendars, phone directories, and general information are all suitable for videotex. Taking the French approach, and supplying a videotex terminal with every telephone would not only virtually eliminate many of the mass mailings to students and faculty, but would also make feasible individually addressed electronic mail. A videotex system could be interfaced with the university's main computer to produce reports, in color and with graphics, for administrators at their desks.

The simplicity and ease of use of videotex would make it ideal for administrative applications which now require special skills. Use of the central computer, even for the simplest applications, requires some training, whereas videotex requires none. It can be used as easily by a stock boy checking on supplies inventories as by the Vice President for Finance checking on the budget status.

So often what is clear to us in computing is not so apparent to others. Administrators look on anything to do with computers with a somewhat jaundiced eye. Even funding for a relatively modest pilot project is not easy to come by. Clemson's videotex project was no exception to the rule.

It turned out that even a small pilot videotex project would require the involvement and support of a number of other departments on the campus. Publications and Graphics, which would create and maintain the database frames; Facilitating Services, which has the responsibility for the dining halls and other public areas in which monitors would be placed; and Communications, which would be involved in installation of the network.

A crucial part of the project was to sell the idea of videotex to those who were in a position to make it a success. Fortunately videotex has a very attractive feature when it comes to trying to impress someone - graphics. The virtues of graphics in a videotex system are debatable, but as an attention-grabber graphics is unbeatable. The graphics capabilities of videotex were attractive to the Publications and Graphics group at Clemson and representatives of that group were persuaded to attend the Videotex 83 conference in New York. What they saw at Videotex 83 convinced them that videotex had a future at Clemson and that Publications and Graphics could be the major information provider on such a system.

Publications and Graphics, Facilitating Services, and Communications were all represented on a campus-wide committee studying the possibility of installing cable TV on campus. Publications and Graphics arranged for the Computer Center to make a presentation on videotex to that committee and, as a result, broad-based approval for the installation of a pilot videotex system was obtained. Additionally, the Athletic Department, which was also interested in the possibility of using using the videotex system for publicity of athletic events, made a modest contribution towards the cost of installing five monitors.

The major financial investment came from the Computer Center and Digital Equipment Corporation. DEC support was crucial since the Center did not have the money available to buy the necessary computing hardware to support a multi-user videotex system. Fortunately DEC also saw the merits of working with Clemson to develop a videotex system based on currently-available DEC hardware and software. DEC therefore provided 50% funding for the necessary hardware with the Computer Center funding the other 50% and underwriting the cost of software development. The system was to be run on a VAX 11/750 and be compatible with the North American Presentation Level Protocol Standard (NAPLPS). NAPLPS was the videotex standard originally proposed by AT&T and widely endorsed in North America.

The software was developed by one person over an 18-month period. The actual time invested by that person was about 3 man years. The system was ready for installation by the summer of 1983.

Problems with the system were almost entirely with the installation. Funding, software development, and marshalling of support went extremely smoothly. The same could not be said for what should have been a simple installation.

The test was to have included five monitors in strategic locations - dining halls, Student Union, Computer Center etc. Only recently have all the monitors been made operational. Problems were experienced varying from interference from microwave ovens in the dining halls to the last minute unavailability of keypads. Nevertheless, we persevered and the system is finally working.

Preliminary results are very encouraging. As expected graphics pulls in the customers even though very little substantive information is presented in graphic form. Once the victim is hooked by the graphics he finds the ease of use of the system to be such that he can without any trouble retrieve pages of information from the videotex database.

We will observe the uce of the present group of terminals for the balance of the school year before making a determination on whether or not to expand the system. It seems likely, given the interest both on and off campus, that the system will be substantially expanded in 1984-85. While we cannot so far claim to have made a dent in the amount of paper flowing around our campus we have certainly caused our administrators to take a fresh look at the way they distribute information. We are still convinced of the potential of videotex, but we have a long way still to go.

DISTRIBUTED ADMINISTRATIVE MANAGEMENT INFORMATION SYSTEM (DAMIS)

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ABSTRACT

Columbia University has embarked on a major program to distribute its central administrative data processing to its various schools and departments. DAMIS will link every department and school via microcomputers, terminals, and/or mini computers to the central administrative computers. Departments and schools will have the capability to enter, track, control and report administrative information that is relevant to their specific needs. DAMIS will also provide local files at the department/school level and, when coupled with the University administrative data bases, will satisfy the majority of their administrative information needs in an on-line environment.

1. OVERVIEW

1.1 The Problem

Columbia University is a complex organization for many reasons. First of all, Columbia has several campuses with 25 schools and over 200 academic and administrative departments. Columbia has a population of over 30,000 students and employees. Thus, Columbia is not unlike other major teaching/research institutions and not unlike major commercial organizations. Complexities arise not from specific teaching, research, and administrative functions, but arise from the interrelationships of these functions. For example, Columbia incorporates a number of administrative processes and procedures. One example is that the registration process is a centralized function, whereas admission procedures vary from school to school.

In 1979, Columbia commenced a program to replace several key systems with packaged, i.e., vendor-supplied, systems to offset many of its problems. Two such system installations were the Financial Accounting System (FAS), to provide the University with a basic accounting system, and the Student Records System (SRS). Despite the benefits reaped by the departments and schools, much of the information provided by these packaged systems, after four years of installation, are still not timely nor accurate.

Information is disseminated to departments monthly and they usually do not receive a copy of their reports until two weeks after month-end. This dated information, along with the usual voluminous amount of unneeded data, has proven to be too much and too late for departments to make timely decisions. To alleviate this problem, almost all of the departments maintain manual records, and some of them have gone to the extent of computerizing their financial records. In addition, the problems of timely and accurate information by University systems has prompted departments to extend their manual data processing (and automated record-keeping systems in some cases) to these areas.

Record-keeping, whether manual or computerized, represents a duplication of effort for data entry -- once to the department's system and again to the University's main core system. Although this procedure is a burden and an expense to the University, the departments maintain that it is necessary for timely and accurate information. These systems create as many problems as they try to solve. For example, the manual systems do not provide reporting capabilities such as "how much money was spent with vendor X". This information is available, but searching the records manually is too time-consuming. This is also true for departmental computerized systems. One such system, for example, requires 40 hours of uninterrupted machine time to print monthly reports, making easy access to data virtually non-existent.

During the early part of 1982, an extensive survey was conducted at Lamont-Doherty Geological Observatory (one of our research facilities located in Palisades, New York) where there is a computerized local record-keeping system. The Lamont system does not satisfy local needs for two reasons: a) it is cumbersome to use and takes a longer than desired cycle to provide the required information, and b) it does not interface or reconcile to the University's core systems. The study discovered that although there were technical problems with their system, it did provide them with more current data than available through FAS. The study outlines the strengths and weaknesses of Lamont's system. The strengths are: accessibility, convenience, responsiveness, flexibility, self-reliance, and relevance and the weaknesses are: reliability, capacity, penetration, integrity, integration, and self-sufficiency. Similar results were obtained from discussions with departments at the College of Physicians and Surgeons which had automated record-keeping systems.

From the Lamont study, we identified key benefits that resulted from local record-keeping systems. It was concluded that if the local record-keeping system had been designed as an off-shoot (or integrated with the core systems), many of the problems with the local systems and their relationship to the core systems could have been avoided. The study was completed in June 1982, and soon thereafter the concept of Distributed Administrative Management Information Systems (DAMIS) was formulated.

1.2 Developing a Global Strategy

Before DAMIS could be implemented, we had to devise a **global solution** for creating an administrative systems capability into the 1990's. Essentially, we have a three-fold strategy:

1. Continue upgrading Columbia's administrative core systems. However, the enhancement process would be an on-line, data base management system, report generator environment. Essentially, a program is in place to rebuild our systems, utilizing data base technology. The key University data bases will be the:

   - Human Resources Information Data Base
   - Student Information Data Base
   - Financial Information Data Base
   - Alumni Information Data Base
   - Facilities Management Data Base
   - Health Sciences Management Information Data Base
   - Library Data Base (academic and administrative)

   Other data bases will include Student Services, Public Information, Housing, Materials Control, and Investment.

2. Continue upgrading our administrative computer hardware, communications, and operating system software capability. To that end, we are proceeding with a number of activities to upgrade our hardware, utilities, operating systems software, and data base management system software.

3. The **distribution** of information to schools and departments by **down-loading** or **up-loading** data. This concept is called DAMIS (Distributed Administrative Management Information System).

2. IMPLEMENTING THE STRATEGY

ADMINISTRATIVE SYSTEMS

Basically, the Center for Computing Activities (CUCCA) Administrative Data Processing (ADP) is attempting to satisfy the administrative requirements of specific users, and to build a set of integrated systems that are responsive, online, and considers the needs of departments and schools.

2.1 Human Resources Information Systems

2.1.1 The Past

- In 1977-78, the Personnel Information System (PIS) was implemented to provide the University with fundamental data of personnel information on all Columbia employees (except casuals).
- In 1980-81, the Effort Reporting System was developed and implemented and subsequently incorporated in the new Labor Distribution System.
- In 1981-82, a major modification to the Affirmative Action System was designed, programmed, and implemented.
- In 1982-83, the new Labor Distribution System was developed to overcome numerous problems that were never resolved by the installation of the MSA Payroll System and the Financial Accounting System (FAS).
- In 1982-83, a new Benefits Information System (BIS) was planned and designed. Installation will begin in early 1984.
- A new Applicant Flow System has been programmed and will be implemented in January 1984 to track job applicants.

2.1.2 The Present and Future

The key element regarding HRIS is **redesign** and **integration**. To that end, the following activities will take place:

- The Payroll System and LDS will be on-line in 1984.
- A new BIS will be implemented and integrated with PIS.
- The key Human Resource Systems (including PIS, BIS, LDS, and Payroll) will be integrated via a Data Base Management System (DBMS). Data entry for the systems may be integrated, and the data base will be linked to the IBM Mass Storage System (MSS) so that data accumulated during a ten-year period may be easily accessible.

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2.2 Financial Systems

2.2.1 The Past

In early 1980, the Financial Accounting System (FAS) was designed and programmed for the Controller's Office by Information Associates Incorporated (IAI), and was installed under the auspices of Peat, Marwick, and Mitchell. The system, which went live in July 1980, was intended to solve the financial accounting problems of the University schools and departments. Although FAS is reasonably sound, it still does not fully address local needs of the schools and departments. Also during that time, a new IAI Accounts Payable System was installed, which further compounded the problems of central administration, schools, and departments. Additionally, FAS was deficient in the area of Fiduciary Accounting and Governmental Historical Reporting.

- Major modifications were made to FAS in the area of data base and reporting, including development of new detail and summary reports.
- A new Fiduciary System was installed to cost out payments from the investment office.
- The Accounts Payable System was modified extensively to improve the operating and research characteristics of the system; the system was put to improve invoice research.
- In late 1980, the OPG System was developed by CUCCA ADP to track (on-line) progress on all applications for projects and grants, including development of the budgets and tracking of personnel on the projects. It was recently interfaced to FAS to input budgets directly. The system also has several major subsystems, including a Subcontract System, an Institutional Review Board System, and a Patents Subsystem.
- In 1981, a Space Management Inventory System (INSITE II) was installed to track space and inventory for compliance with new government (A-21) regulations. This system tracks and designates all of Columbia's usable space for functional usage by departments and schools. Additionally, the system tracks all inventory of equipment that falls under A-21 classification.
- In late 1982, a new Purchasing System (called CAPS) was designed by CUCCA's ADP. It will be on-line and expected to be operational by early 1984. This system will eventually be extended to schools and departments -- a major enhancement in their efforts to gain control of their environment and to create a timely purchasing operation.

2.2.2 The Present and Future

The key elements of the Financial Systems will be to **upgrade, redesign** and **integrate**. Essentially, the following activities will take place:

- FAS will be extended to the schools and department via on-line.
- A new integrated Purchasing/Accounts Payable System (APS) will be developed which is totally on-line linked to a DBMS and a report writer.
- A proposal is under way to review the possibility of linking the major financial systems to a DBMS. These systems will include FAS, CAPS, APS, DFAFS, OPG.

2.3 Student Information Systems

There are two segments to the Student Information System structure – the central University system, and the school systems.

2.3.1 The Past

- The oldest of the student core systems is the Student Loan System (SLS), which was designed by Information Associates (IAI) and installed in 1977. It gives the University the ability to record both Government and University student loans. This system holds these loans in the appropriate grace period and then issues bills on a monthly, quarterly, or annual basis, reflecting any interest due on unpaid balances.
- In 1979, the University implemented the IAI Billing and Receivable System (BRS). This system coordinates charges, payments, and credits from all departments interacting with a student's financial record. Monthly bills are produced which reflect interest charges if there are any overdue balances.
- In 1981, a Holds Sub-system was installed to provide information to the Registrar regarding students whose accounts were not current in their payment to various areas such as the Bookstore, the Libraries, and the Bursar's Office (Student Loans, Billing and Receivables, etc.). Also, holds implemented by deans or the Registrar are recorded in this system. The process of withholding grades, transcripts of records, and diplomas has been improved by this system.
- A new Student Records System (SRS), also designed and modified by IAI, was installed in January 1982. The features of this system include the recording of registration, course, instructor, classroom site, and grade data. The system not only receives data from BRS, the School Admission System (including data from Barnard and Teachers College), and the Holds Sub-system, but passes student information to the individual school's student record system. In addition, data is provided to satisfy government reporting, including Federal Certification.
- As a result, the reports gave a more meaningful representation of data.

- In January of 1983, On-line Inquiry to the Student Records System (SRSIS [illegible]s developed for the Office of the Registrar.
- During 1983, the Admissions and Financial Aid Systems were completed for two particular schools, i.e., Columbia College and the School of Engineering (undergraduate). Using the systems of these schools as models, the School of Nursing will implement an Admissions System and the Faculty of Medicine (at the College of Physicians and Surgeons) will implement a Financial Aid System, both by the end of 1983. A School Student Records System also makes available to both Columbia College and the Engineering School student data for their particular needs, and includes inquiry, updating of information, report generation, and word processing.

2.3.2 The Present and Future

During 1984-86, it is planned to revamp and redesign the Student Information systems. We envision a completely integrated Student Record System (student records, billing, financial aid, housing, and dining services) with direct links to the various school Admission and Financial Aid Systems. The envisioned system will be accessible by staff and students via on-line terminals and will, in "bank-like" fashion, provide a variety of functions. It is expected that the proposed system will replace much of our existing software. We still, however, continue to service the various schools with local admissions, financial aid, and inquiry to the core Student Record System and Billing data bases.

2.4 Alumni Records and Gift Information System

2.4.1 The Past

Alumni information is available primarily from the core system known as Alumni Records and Gift Information System (ARGIS) and is used by the Office of University Development and Alumni Relations. The system contains a data base with records of over 250,000 prospects, of which 165,000 are Columbia alumni. Each prospect record contains biographical, demographic, educational and employment history, and multiple gift records denoting past donations as well as pledges. The system was implemented in 1966 and has undergone many modifications. The most extensive of modifications occurred in 1979 to accommodate fund-raising for the construction of our East Campus dormitory, and in 1982-83 for the current fund-raising Campaign to raise $405 million. Data is used for reports, statistics, labels, pledges, and telefunds. In 1982, the system was put on-line to the University Development Office and several major schools.

2.4.2 The Present and Future

There is currently a major renovation under way to enhance ARGIS for better efficiency in reporting and access of information to improve service. Other enhancements will enable ARGIS:

- to be distributed on-line to schools that are capable of inputting their own demographic data and inquiring into their own data bases.
- to be linked with the Student Record System for recent graduate information.

- will automate pledge processing on-line

We also plan to link ARGIS to a Data Base Management System.

2.5 Facilities Management

2.5.1 The Past

During the last two years, a number of systems were implemented for the Office of Facilities Management. In 1981, the MIT INSITE System was installed to keep track of floor space and equipment for Physical Plant. In 1983, a new Work Order Tracking System was installed to track all maintenance work orders. This system currently runs under FOCUS.

2.5.2 The Present and Future

Currently, a plan is being developed to create a completely integrated Facilities Management Information System for energy management, maintenance planning, space planning, maintenance planning, scheduling, and other related functions.

3. HARDWARE/SOFTWARE UPGRADES

A key aspect to supporting a distributed environment is the placement of an adequate hardware/software environment. To that end, an in-depth analysis of the needs of administrative computing was made. The following decisions and plans were devised:

- Central administrative hardware will be upgraded from the IBM 3031 and 4341 to the IBM 3083 and 4341 II, in order to increase capacity by over 50%, and is scheduled for December 1, 1983. Afterwards, the 4341 II will be upgraded to either a Model 12 or 3083.
- Operating systems software will be upgraded in 1983:
    - * VM will be upgraded to VM/SP2-HPOR3
    - * MVS will be installed on the 3083, replacing VS1
    - * The COMTEN 3670, which is now used for administrative communications, will be upgraded to a COMTEN 3690 in order to increase our front-end capacity by 500% and to run the Systems Network Architecture (SNA) [SNA slated for installation in 1984]
    - * Several mini-computers will be integrated into the hardware environment, including a VAX 750 and an IBM S/38.
- A microwave tower has been installed in November 1983 to transmit data between our Medical Center (168th St.) and the Main Campus (116th St.)
- As of November 1st, approximately twelve PCXT workstations have been linked to the administrative network, and data is being downloaded to these PCs as a result. It is expected that this number will quadruple in 1984.

4. DAMIS STRATEGY

The concept behind DAMIS is to distribute central administrative data processing to the various departments and schools. DAMIS will, when fully implemented, link every department and school via personal computers, terminals, and/or mini computers to central administrative computers. Academic departments and schools, as well as administrative departments, will have the capability to **enter, track, control and report** administrative information relative to their special requirements. In addition, DAMIS will provide local files at the department and school level and, when combined with administrative data bases, will satisfy the majority of their administrative information needs in an on-line environment. The system will:

- provide local data editing as it is entered at the user's location to ensure that it is **clean** before being passed to the core system. A method of correction will be provided to ensure that information is error free, whether the information is released to the core system or remains at the front end.
- provide a **filter** where data needing approvals will be linked to the appropriate University personnel for examination. Data will then be released to the core system if approved.
- have inquiry access to core system and/or file subsets, depending on what is appropriate. Access capability, via terminals, will allow users to locate information about their files immediately.
- allow users to inquire about their own data. A security program forbidding unauthorized use will be implemented.
- have tracking capability which would allow users to compare cumulative and/or monthly transactions with monthly statements. Reconciliation will be much easier as a result.
- provide local record-keeping that is specific to the user but not necessarily to the central administration. Depending on user needs, it may be appropriate to store record-keeping information on a mainframe or micro-computer.
- provide methods of generating reports, in user-specified formats, by the host or local systems (depending on volume of data).
- allow data to be transferred into local systems for manipulation by the user. Commercially-available software, such as VISICALC, can then be used to obtain information (that previously took too long to get) for making more effective and timely decisions.

DAMIS, when implemented as outlined, will alleviate many of the frustrations departments now have with obtaining correct data from the core systems. The apparent benefits of DAMIS, therefore, will be:

- reduction in time to research problems;
- more easily reconcilable systems;
- consistent and integrated department capabilities as opposed to stand-alone (non-standard) systems;
- potentially control expenditures, resulting in reduction or elimination of overdraft situations;
- reduction of overall processing errors;
- enhancement of local decision-making capabilities by means of down-loaded data to local systems for manipulation by users.

5. THE DETAILS OF DAMIS

The first phase of DAMIS deals with distributing financial information to departments for supporting local decision-making. Initially, we're using IBM's XT personal computer (PC) as a local device, but we will be testing similar applications using IBM's System 38 and Digital Equipment Corp.'s (DEC) VAX computers. The PC was chosen because of its flexibility and low cost for testing the DAMIS concept of inputting and down-loading University data. Because each of the pilot departments were paying for their own equipment, they also felt that the PC would be helpful in their department, even if the pilot was discontinued.

DAMIS is divided into three main sections:

- department/school needs and capabilities not satisfied by University core systems;
- department/school needs and capabilities satisfied by the University core systems;
- integration of local (department/school) capabilities with University core system capabilities.

5.1 Local Department and School Systems

The local needs are extremely important to users and are the main reason for their enthusiasm. In Phase One, the local system will include a basic bookkeeping system for maintaining immediate information on the status of their accounts. Commercially available software has been evaluated, but we have been unable to find one that encompasses encumbrance accounting and is sufficiently large in scope to handle the complexity of a large University. Therefore, we are developing our own.

The bookkeeping system will use standard accounting procedures, but this is not intended to replace the University's FAS. Rather, it augments FAS with information important to departments, but not necessarily to the University in general. Transactions will be keyed into the PC to update their local bookkeeping system and also go into a separate file for subsequent up-loading to the host systems. A user will be able in inquire, report, and calculate against the local system.

Users are also using commercially-available software for maintaining information locally, i.e., LOTUS 1-2-3 and Aston-Tate's DBASE II. 1-2-3 is being used when spread-sheet applications are needed and DBASE II for data base applications. These were chosen to allow users the option to modify the system for their own requirements. Most are also using a word processing package for combining information from 1-2-3 into text documents.

5.2 Host Systems

The host systems contains information that is invaluable to departments. In the past, this information has not been available to end-users. Through DAMIS, we will be allowing users to gain access to information concerning their own departments.

Phase One of the pilot will allow users to gain access to the on-line FAS and Accounts Payable (AP) systems. Although these on-line systems were previously in use by the Controller's Office, major modifications and screen changes were implemented. A security system allowing users to view only their own data was incorporated.

All of the Administrative Data Processing Systems are on IBM mainframe computers and are accessed by 3270 terminals. Access by PCs via asynchronous links, however, is capable only through a protocol translator made by DATASTREAM, Inc. We will be upgrading to an IBM Series/1 computer.

5.3 Integrated Systems

Integrating local with host systems is the most challenging area, and an area where major savings can be achieved. **Information float**, i.e., the time it takes for information to pass from one area to the next through the approval chain, can be greatly decreased and the accuracy of data improved with on-line systems. Data available on the host system could be manipulated by PCs using available software already on the market. This should allow users to design specialized reports not available through host systems and not to impact the hosts.

As mentioned previously, the local bookkeeping system will contain a file for up-loading into the host system. In fact, data will go into a queue file on the host which will allow the Controller's Office to review information and approve transactions for updating FAS. Transactions that are not approved will be so noted and left in the queue for appropriate action by the user. Users will only be able to view their own transactions in the queue, i.e., transactions of other users will be invisible.

Transferring data from the host computer to the PC will be possible, as well as formatting for appropriate software packages (1-2-3 and DBASE II). For the pilot, the selection will be made at the host by account number with a pre-defined set of data elements. However, we are evaluating a common user interface that will reside on the PC and allow one standard interface. This interface will make the necessary translation for obtaining information from different systems.

Asynchronous communications protocol will be used for the transfer of data, and was chosen because it is the least expensive way for communications at Columbia. A program developed at CUCCA called KERMIT will assure data integrity. Because of the distance involved, a communications speed of only 4800 baud will be achieved. A microwave link is being used between the Medical Center and the Main Campus.

The following advantages to integrating the systems will thus be achieved:

- distributed equipment will off-load host cycles;
- users help will fund cost of distributed computers;
- users will have ability to tailor systems for their own reporting requirements;
- users will be responsible for their own data entry for obtaining more accurate and timely information;
- there will be a less need for data entry clerks and data production coordinators;

In order to make the system easy for the occasional user of computer systems, we designed a menu (for use on the IBM PC) which will automatically be displayed once the user starts the system. The menu is mnemonically driven and the use of special keys is not needed. This allows the system to be transported to different PC's without major modifications. A menu bypass system allows an experienced user to navigate through the system with few menus. A security system allows only valid DAMIS users access to the DAMIS programs and files and non-DAMIS users can access to other (non-DAMIS) program and files.

DAMIS is the first project at Columbia where PCs are being placed on managers' desks. The success of DAMIS requires that pilot users gain a knowledge of personal computers and how they interact with host systems. To do this, a training curriculum was implemented. Though PCs are not easy at first, many managers have found that they were not impossible to learn. The Office Automation Group of CUCCA has found that the best way for teaching the uses of the PC was to have students use a computer-based instruction (CBI) course (using selected software packages) after they have attended an overview class. The overview classes last approximately two hours and teach the basic concepts of the operating system or the software package(s). The CBI should encourage students to practice what they are taught as the course proceeds.

After Phase I of DAMIS is complete, the project will be analyzed and, if necessary, redirected. It is expected that the pilot project will provide us with needed information to provide an objective assessment of the project direction. At this point, there are still many questions and a variety of potential solutions. However, until we follow through with a pilot, we will not be in a position to accurately determine which solution is best. It should be noted that this project will not only change automation aspects, but may change basic operating procedures at the department level, the interaction between central administration and departments, and the central administration level.

COMPUTERIZING THE BUDGET OFFICE:
An On-Line Decision Support System

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The University of Connecticut Budget Office has created a fully on-line decision support system using the school's existing information system to provide management with instant and unique views of the financial data base. The highly versatile language FOCUS is used to interactively access the data without programming assistance from the Computer Center's staff. The paper recounts the implementation process and resource requirements, describes the attributes of the system and evaluates the successes and failures of shifting to a fully interactive budget review and development process. Special attention is given to the personnel problems and analytical challenges encountered in the evolution to computerization. Examples will be cited of financial models and graphics used to facilitate meeting internal and external information requests, perform complex revenue and expenditure analyses, and prepare multiple versions of the annual $200 million budget request.

The University of Connecticut Budget Office has embraced computer technology to develop, market, implement, control, and analyze the school's $200 million operating budget. A comprehensive on-line decision support system, which was created without substantial improvement to the University's batch mode production information systems, is accessed by using FOCUS, a fourth generation report generator. The experiences at the University of Connecticut serve as a model for institutions that need to computerize retrieval of management information but which are unable to divert substantial resources to the development of state-of-the-art transactional processing systems.

I. ATTRIBUTES OF THE BUDGETARY DECISION SUPPORT SYSTEM

1) Technical - The Budgetary Decision Support System (BUDDS) runs on the University's interactive network which is anchored by an IBM 3081D mainframe, with on-line access using VM/CMS. The primary software is FOCUS--the report generator, University of Waterloo SCRIPT--the word processor, and XEDIT--the system editor. The budget staff also uses an IBM Personal Computer linked to the mainframe via Asynchronous RS232 communications and the B3101 terminal emulator. The PC is used with a Hewlett Packard 7470A Graphics Plotter and CHARTMAN II graphics software to produce high quality bar, pie, line and text charts.

2) The Data Base - The Budget Office accesses several primary files that are resident on the main computer system and the Office has created scores of other subsidiary files using the extraction, matching and joining capacities of FOCUS.

The key data files used in BUDDS are:

1) Summary Expenditure Information (last four years on-line),
2) Personnel Information (current data only),
3) Budgeted Position Control (last two fiscal years on-line),
4) Budget Requests and Allotments (current fiscal year), and
5) Table of Budgetary Expenditure Accounts (current codes only).

In addition, the Office has created and accesses the following files:

1) Budget Development File (merges data from the five key files),
2) Budget Request Tracking File,
3) Executive Permanent and One-Shot Allotment Tracking File,
4) Energy Usage/Price File and Projection Model,
5) Interactive Tuition Projection Model, and
6) Collective Bargaining Interactive Negotiation Model.

II. IMPLEMENTING THE BUDDS SYSTEM

Two years ago, the data needed to prepare and monitor the budget was controlled by the University's Administrative Data Processing (ADP) Group. Computerized access to the files was restricted to the professional programming staff. While the ADP Group acknowledged the user's needs for timely and accurate analysis, the computer programming staff was unable to respond to the continuous requests for unique aggregations of financial data because of higher priority projects. The limitation on direct user access meant that the Budget Office was relegated to using cumbersome detailed accounting reports to support a manual budget development and control system.

Inflationary pressures at the end of the last decade coupled with annual mid-year recisions of appropriations forced the budget staff to expand its capacity to control and identify opportunities to reallocate funds. The Budget Office needed to examine the spending patterns of departments to identify problem areas for the vice presidents and to suggest supplements to the yearly allotments. The Summary Expenditure Information file contains allotment, encumbrance and expenditure data which is required to analyze the departmental spending patterns. The Computer Center staff proposed to assist the Budget Office by placing daily output of the current year Summary Expenditure file to disk for on-line read-only retrieval as needed. The main constraint of this proposal was the lack of on-line programming experience by the budget staff.

The initial training experiences severely deflated the enthusiasm of the budget staff. They attended presentations which were geared for students and academic users and the budget staff found many of the examples difficult to apply to administrative user problems. The intervention which saved the experiment came when the ADP staff personally assisted the budget staff by providing solutions to many technical problems.

The first special reports which were generated quickly enhanced the control function of the office. Unique aggregations of expenditure data allowed the budget managers to gain new perspectives on the allocation and disbursement of funds. Problem spending areas were identified by calculating a percentage of commitments to date against an allotment. Sorting the output simplified exception analysis and saved the staff from the time-consuming aggregation and calculation of the status of each expenditure account. The computer opened an opportunity for staff to isolate emerging budget shortages and resolve problems before they worsened. Additionally, computerized searches for strings of data enabled the office to audit the accounts far more rapidly than previously was possible.

III. MANAGING THE BUDGET PROCESS

A. Budget Development

The University of Connecticut Budget Office prepares five unique versions of the school's $200 million spending plan during an 18-month budget development cycle. A different submission is required to conform to the budget format used by each recipient. These budget types include:

1) Board of Trustees - program budget by school or department
2) Department of Higher Education - major line item by campus
3) Office of Policy and Management - detailed minor line item by function
4) Legislative Appropriation's Committee - all of the above (as required)
5) Departmental Allotments - detailed by minor line item and function.

The data required to assemble these budget requests comes from nearly every financial and personnel data file. The Budget Office formerly requested annual printouts of the basic data that were produced in formats which had remained unaltered during the last decade. The two budget staff members charged with developing the budget calculations in each of the unique formats for submission were faced with an overwhelming annual task of aggregation.

The current budget development system is fully automated and provides more flexibility and guarantee of accuracy than its manual predecessor. FOCUS enables the budget staff to create a system which is used to analyze, model, and prepare the statements and forms that are required by each reviewing agency in final copy-ready form. Files are created by extracting the required elements from the main data base files with sufficient foresight to anticipate components needed to aggregate the data into the budget formats. The key digits enable the office to link data from distinct physical files to form a new data base.

The Office uses an interactive budgetary development model which details additions to the base and quickly provides a bottom line for all alternatives. The model consists of 1) a Request Tracking File which contains the key code and description of the detail budget request and, 2) a spreadsheet which compares current year and requested year amounts by major line item and program. These two files enable the vice presidents to finely hone alternative requests and immediately view the impact on the bottom line. Revenue required to fund the budget is projected using an Interactive Tuition Projection Model. This model allows the alteration of enrollment assumptions and provides for the calculation of differential tuition rates along the dimensions of residency status, level of instruction, and school.

Calculation of the University's personnel budget is complicated by the presence of 11 different bargaining units on the campus representing 4400 employees. The Office of Policy and Management--the Governor's budget office--requires detailed calculation of the budget request by bargaining unit in addition to the detailed line item and functional submission because it must prepare a centralized request to the Legislature for funding of unsettled contracts. Extreme accuracy is required since a small calculation error could have enormous impact on the General Fund personal services appropriation which exceeds $80 million. FOCUS is used to match the Personnel Information File with the Budgeted Position Control File to create an extracted file containing the account code, bargaining unit identifier and personnel classification data by individual employee. This file is run against an algorithm which determines the impact of the 11 contractual settlements along each of the dimensions of the budget submission.

The computer is also used to prepare the final copy of all budget presentations. The Board of Trustees program budget contains two pages for each school or division. The first page includes detailed descriptions, activity level data, and output indicators. The Office of Institutional Research maintains the data base needed to update this material and uses the University's word processing software, SCRIPT, to create this report. The top half of the facing page contains the budget request detail by source of funds and major expenditure line item. The lower half of the second page contains a personnel matrix which summarizes the position allocations by fund source and type of position. The second page of each departmental request is prepared using the FOCUS financial modelling language and is printed in final form. The development of the files and programs used to generate the budget document allows the Budget Office an additional month to prepare the Board of Trustees Program Budget. This extension offers the University's top management a chance to more effectively evaluate the proposals which it submits to the governing board.

B. MARKETING THE BUDGET

As a public institution, the University annually presents its budget to four governmental units charged with oversight of the school's fiscal affairs. The Budget Office works with the Vice President for Finance and Administration to assure that the University's positions are clearly articulated and understood. Computerized business graphics are incorporated with tabular reports prepared directly from the data base, to sell the "political" budget in oral and written presentations. Bar, pie, line and text charts are created to explain policy alternatives and computer generation of graphics allows the Office to test various presentations and easily alter the charts to assure maximum impact.

FOCUS enables the Office to tabulate budgetary information exactly as requested by the reviewing bodies. The Office maintains a library of special formats and a core body of software which is quickly modified to react to the unique demands. Responses are often prepared within minutes and sent to the requestor. The Office also uses the electronic transfer of files to accounts on the University network to speed delivery of information. The increased speed and level of responsiveness has enhanced the University's credibility in the State Capitol and strengthened its bargaining power.

C. IMPLEMENTATION, CONTROL AND ANALYSIS

The most important function of the Budget Office is the allocation and control of departmental budgets. The General Fund appropriation and Tuition Fund authority is translated, each July, into line item departmental allotments. These allotments are based on historic funding levels (prior years' permanent allotments), one-shot needs, enrollment or service demand, and new program needs. FOCUS reports revealing a department's spending history from the Summary Expenditure File are combined with the Budget Request File to become the vice presidents' worksheets for determining departmental funding levels. Subsequently, allotments are directly input to the accounting system from the Budget Request File. FOCUS also is used to assure that the allotments in the Current Year Summary Expenditure File balance with those contained in the Budget Request File. Every month, the vice presidents receive a six-part report which summarizes the allotment levels within their purview. These reports, which are generated from three FOCUS files maintained by the Budget Office, enable the institution's executives to closely monitor budgetary commitments and assure that allocations are obeyed.

A menu-driven Executive Budget System eases access to the control reports within BUDDS. The dialogue manager feature within FOCUS is used to elicit responses from an analyst reviewing the budgetary accounts. Budgets may be viewed from several directions. Normally an exception analysis is run by major object of expenditure to determine if overall spending is within the allotment limits. Excessive or insufficient spending patterns are highlighted by ordering the report by percentage-spent-to-date. A second inquiry direction allows the analyst to view detailed allotments and commitments by department. This helps the Office to quickly isolate problem areas without poring through hundreds of pages of expenditure detail.

The on-line Summary Expenditure File contains information which is current through the last scheduled update. On-line access enables the Budget Office to extract information from the accounting system up to seven weeks earlier than previously possible. Detailed transactions are available only through hard-copy reports since the disk storage requirement is excessive and is not cost justified. The on-line output helps the Office provide reliable, timely control information to University managers. Access to the Current Year Summary Expenditure File will soon be available to all departmental managers with terminals on the network.

D. PROJECTIONS AND MODELS

FOCUS contains a facility which simplifies the creation of complicated financial models. The Budget Office generates models to project the impact of alternative collective bargaining settlements, tuition levels and enrollment patterns, and energy consumption and price changes. The modelling language allows the Office to precisely tailor output in print-ready form including the insertion of standard accounting statement conventions.

The Collective Bargaining Interactive Negotiation Model was developed during the past round of negotiations with the professional employees union. Within seconds after a settlement is proposed, the financial impact of a package is determined. The model's variables, including salary percentage increases, annual increments, and merit pools are projected for the length of the contract. The printed report contains a calculation of the actual and annualized cost and percentage increase for each year. The development of the model encouraged management and union representatives to move the site of the bargaining table to an office with a terminal and a high speed printer. During the final financial negotiations, the model was used to generate a dozen proposals and tentative agreement was quickly reached.

The Interactive Tuition Projection Model forecasts the revenue impact of changes in enrollment at each of the University's six campuses within three categories of residency and three levels of educational program. The tuition rate and enrollment level are altered to produce a projection of a tuition increase by campus, residency and level. The model summarizes the total income and the percentage increase of the changes.

The Energy Projection Model forecasts the current year and succeeding year budgets by analyzing year-to-date cost and average consumption rates from previous years. Current year actual price and usage data is combined with prior years' consumption data for subsequent months by fuel type and campus. Prices are projected by multiplying the current rate by a percentage increase or decrease during the succeeding months. The data used in the model is displayed on a line chart using the FOCUS graphics capability. Over the past three years, the Budget Office has projected the cost of energy within .5% of the annual $10 million budget by December 30.

IV. SUMMARY

The University of Connecticut succeeded in its experiment allowing direct data access by the Budget Office because of the following reasons:

1) There was an institutional commitment to purchase the proper hardware and software tools.

   a) Excellent report generation software was provided - FOCUS is an extremely versatile and user-friendly language.
   b) The University administration supported the upgrade of computer hardware and software as a high priority.
2) The on-line files met nearly all of the Office's information needs and were used to perform most of the budget functions.
   a) The budget staff was motivated by the ease of data access and aggregation within a short time after implementation.
3) Personal intervention during training was provided by sensitive and knowledgeable professionals.
   a) The staff of the Administrative Data Processing Group personally trained the core Budget Office staff to use the on-line tools and provided encouragement at the bleakest hours.
   b) The Budget Director insisted that staff use the computerized tools, led the conversion by example and continuously mollified recalcitrants by suggesting and/or programming new applications.
4) The staff achieved a high level of personal gratification and university recognition for being at the leading edge of office technology.
5) Terminals were placed at the work station of each analyst to increase ease of access and raise perceived peer prestige.

The experience at The University of Connecticut can easily be replicated at other institutions. The direct access to information will improve management decision making and justifies the marginal costs of acquiring a quality report generator, investing in hardware, and training user staff.

EXECUTIVE DECISION MAKING: USING MICROCOMPUTERS IN BUDGET PLANNING

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Chicago

Illinois

The IBM Personal Computer and VisiCalc software were key tools in a decision support system designed to assist the Vice Chancellor for Administration prepare for an anticipated budget crisis at the University of Illinois at Chicago. When campus executives were instructed to cut budgets and reallocate funds to produce a "Doomsday Planning Budget", the Office of Campus Planning developed a microcomputer based system to analyze both historical funding and current resource allocation patterns. In addition, the system includes a "what-if" module which permits decision makers to test resource allocation alternatives. A summary report identifies the effects of substantial budget cuts on services to students and faculty.

EXECUTIVE DECISION MAKING: USING MICROCOMPUTERS IN BUDGET PLANNING

INTRODUCTION

A budget is more than a statement about money, it is the end product of a critical executive decision making process. In every university, college, department or entity with its own budget, that budget contains a message about the plans and priorities of the unit's chief executive. The budget displays the executive's decisions concerning new initiatives and expansions and contractions of existing programs. It documents his decisions regarding resource allocations. Moreover, the budget puts the executive's decisions on the line making them visible to the persons to whom the executive is accountable.

While ultimate responsibility for budget decisions rests with the chief executive of the budget unit, a host of others influence decisions made throughout the process of drafting budget requests and throughout the process of allocating resources within the budgeting unit. For example, a vice chancellor is influenced by the deans who report to him, by his peers competing for resources, by the Chancellor and, of course, by his own staff who provide information and advice. The amount and type of influence each of these constituents exercises depends upon the problem solving and decision making styles used by the executive.

In the university environment collegial decision making is viewed as the norm, especially in academic departments. However, we are accustomed to seeing a variety of styles. As described by Chaffee[1], budgeting, like all complex decision making exercises, involves a blend of decision making styles. Decision makers use political, collegial, bureaucratic, and rational styles at different stages of the process. The mix of these styles will vary depending upon the importance of the decision, the time available in which to make the decision, the power of the constituents influencing the decision maker and the position and personality of the decision maker.

However, in the last few years, two major external forces -- one economic and one technological -- have profoundly influenced decision making styles in universities, especially in relation to budget and resource allocation. First, fiscal stringency and projected enrollment declines have created a demand for greater accountability and necessitate the acquisition of better information regarding fiscal matters. Second, improved computer technology and better understanding of the executive's informational needs have made available more appropriate and timely information. Both of these forces have resulted in the increased popularity of rational decision making.

Both economic and technological forces were at work last winter at the University of Illinois at Chicago when the sudden disclosure of a shortfall in expected state revenues precipitated a University-wide budget crisis and a call from the President of the University for a "Doomsday Planning Budget."

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[1] Ellen Earle Chaffee, Rational Decisionmaking in Higher Education (Boulder: National Center for Higher Education Management Systems, 1983).

In December 1982, Governor Jim Thompson announced that the State of Illinois was facing a budget crisis. Like many of her sister industrial states, Illinois was suffering because of the nation-wide economic recession. There was a shortfall in expected state revenues, principally due to reduced sales tax income and an increase in state expenditures for unemployment insurance and welfare payments. The Governor ordered a roll back in budgets, including a 2% budget cut, a $7.1 million reduction, for the University of Illinois.

After due consideration, the President of the University decided that all constituents --faculty, administrators and students-- must share in the pain of the budget cuts. Although the University had no salary or price increases at the beginning of the fiscal year, a planned salary increase for January was delayed and an emergency mid-year tuition increase instituted in order to balance the adjusted budget. In light of the bleak outlook for fiscal 1984 and the possibility of the legislature cutting between five and seven percent from the higher education budget, the President ordered the campuses to develop a Doomsday Planning Budget. Our campus, the University of Illinois at Chicago, was to plan for a decrement in state funding of approximately five percent.

Like Gaul of ancient days, the campus has three major divisions, each with its own chief executive: the Vice Chancellor for Academic Affairs, the Vice Chancellor for Health Sciences and the Vice Chancellor for Administration. These three executives, who had been friendly competitors for incremental funding in the past, now had to confront the distribution of a budget decrement.

The Doomsday Planning Budget represented a critical decision making exercise, the outcome of which could have had serious impact on the affected departments and even on the quality of life on the campus. Furthermore, the exercise was to be carried out in a very short time period. In this paper, we will address ourselves to how support was provided to the Vice Chancellor for Administration for this exercise.

In reviewing the problem facing the Vice Chancellor for Administration three major objectives emerged:

- To prepare a Doomsday Planning Budget request which, when reviewed by the Chancellor in competition with budget requests from the two other Vice Chancellors, would show clearly and strongly the negative impact on faculty and students of dramatic budget cuts in support services.
- To examine the manner in which resources were allocated among his units and find ways to absorb budget cuts without endangering the integrity of the entire support service operation.
- To analyze and respond quickly to various allocation strategies suggested in discussions with the Chancellor. and other Vice Chancellors.

The Vice Chancellor had a budgeting process in place. For a number of years, the administrative services units engaged in a modified approach to zero-base budgeting. The process included an annual review of unit functions in which priorities and costs were examined. An Operations Management Board (OMB), composed of unit directors, faculty and student representatives, conducted open meetings to review and prioritize requests for additional funding and new programs. The Vice Chancellor, in conjunction with his executive staff, reviewed the OMB recommendations and made final decisions on budget allocations.

The budgeting process included for several years a mix of collegial and political decision making. On the one hand, there were open meetings, discussions, compromises and a final consensus on a recommended list of priorities regarding the operating budget. On the other hand, internal political considerations greatly influenced the ultimate decisions. New programs were often funded according to collegial decisions, but for the most part, budgeting was based on a philosophy of incrementalism - a uniform percentage increase applied to all base budgets.

Although the Vice Chancellor planned to continue to receive consultation from the directors reporting to him, he decided to explore and adopt a more systematic, rationally based approach to decision making. Toward this end he requested that the Office of Campus Planning make an indepth analytic examination of the budgets of units reporting to him.

The Vice Chancellor's staff office, the Office of Campus Planning, is charged with responsibility for analytic studies supporting planning and resource management for administrative services units. Members of the Campus Planning staff, including the authors, are experienced at developing small, specialized, information systems to support high level decision making. The Office geared up for a familiar set of project goals. We had to acquire data. We had to tap the vast morass of budgeting, accounting and payroll data available in operation level systems, management information systems, and old budget books. We had to transform the data into information through synthesis and analysis. Then, we had to ensure that the information was useful to the decision maker. The information had to be not only accurate and timely in its delivery, but relevant, and succinct - no information overload, clear, understandable, and responsive to the informational need of the decision maker. But most important and most difficult of all, we wanted to ensure that the information was used - that it was integrated into the complex decision making process. This involved concerning ourselves with communication techniques and organization development techniques necessary to gain acceptance for the study.

It was, in a large measure, this last concern that led us to utilize the microcomputer as the basic tool for this study. The principal decision maker in this situation was the Vice Chancellor for Administration, a results oriented executive, who stays at the cutting edge of management theory and high technology. At the time of the budget crisis, the Vice Chancellor had recently installed an IBM personal computer in his own office and was personally using software products for word processing and time management. In our opinion, he had a high degree of readiness for a trial run at desk-top computing. He was a good candidate for microcomputer based systems on which he could retrieve files to answer ad hoc, unprogrammed questions and operate simple models in which he could vary parameters and examine outcomes. We believed that giving the Vice Chancellor hands on experience in manipulating the information would augment both his understanding of that information and his sense of ownership and thus increase the likelihood of his incorporating the information into the decision making process.

Our plan was to use the microcomputer, spread sheet software and graphics to develop appropriate and persuasive presentations of current and historical fiscal information. Also, we planned to ease the burden involved in varying budget parameters and preparing alternative budgets. An added advantage was that our approach would save us time on two counts. We could develop the system faster on the microcomputer, and because the decision maker felt comfortable using the new equipment, we could reduce retrieval and analysis time by reducing the need for a middle man.

THE BUDGET STUDY

Our system was developed using an adaptive approach to design. We started with a broad identification of the data necessary to meet the informational requirements for budget planning. We opted to limit programming efforts, relying solely on software in place. We then capitalized on our close working relationship with the Vice Chancellor to establish a feedback mechanism allowing him to frequently review and comment on the type of information, the level of access, and the analysis which would be most valuable in his style of decision making. Finally, it was essential that the system be kept flexible since it had to adapt to changing needs in a volatile environment.

In the end, the system structure looks remarkably like the Executive Information Systems described by Rockart and others.[2] The system development process is dynamic. The information system -- depicted in Figure 1 -- has been through two subsequent revisions since the period covered by this paper.

It is difficult to discuss development of our system in neatly defined segments. The three major components -- data, software, analysis -- are interdependent, and build upon one another. However, in attempting to impose some order on the discussion which follows, construction of the database and development of the budget model have been classified as separate topics.

Construction of the Database

Our goal was to create a data cube - an application database that would synthesize the salient internal data for each organizational unit over time and include key variables reflecting the impact of exogenous factors. In constructing a database for use in analyzing the administrative services budget at UIC, we were attempting to create something not available from any single University data resource. The existing databases and MIS are excellent for department level information or for campus-wide aggregations in one area of application, but none could provide the level or diversity of information needed. Figure 2 illustrates the three major stages of the process: identification and extraction of source data, construction of a comprehensive h

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[2] John F. Rockart and Michael E. Treacy, "The CEO goes on-line," Harvard Business Review, Volume 60, Number 1, January-February 1982, pp. 82-88.

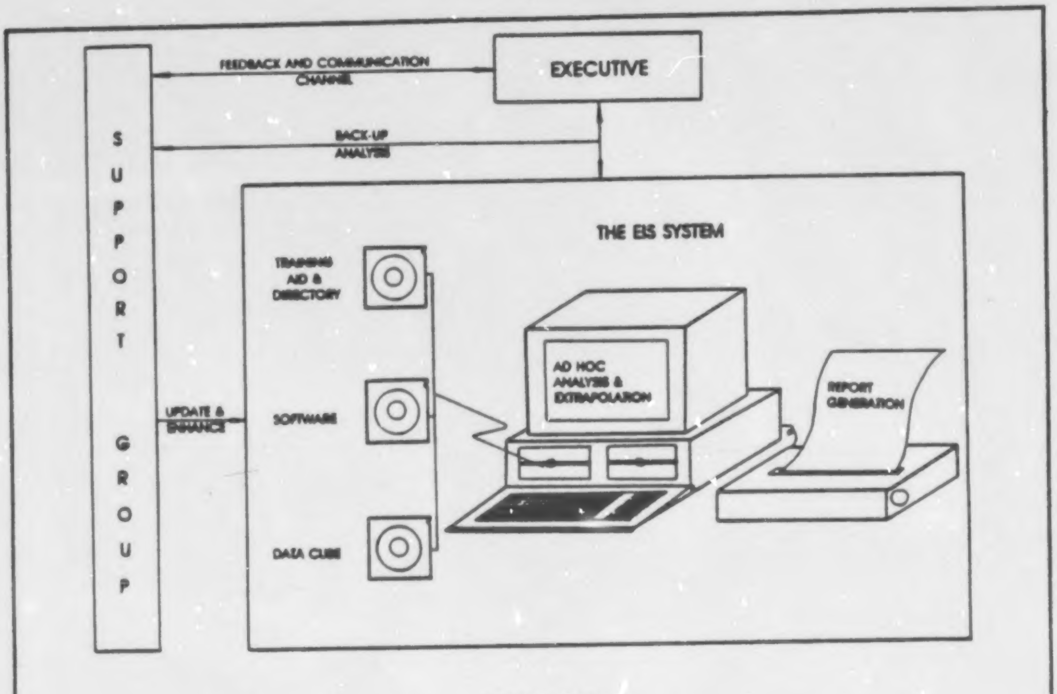
FEEDBACK AND COMMUNICATION CHANNEL
EXECUTIVE
BACK-UP ANALYSIS
SUPPORT GROUP
UPDATE & ENHANCE
THE EIS SYSTEM
TRAINING AID & DIRECTORY
SOFTWARE
DATA CUBE
AD HOC ANALYSIS & EXTRAPOLARON
REPORT GENERATION

FIGURE 1
OVERVIEW OF THE EXECUTIVE INFORMATION SYSTEM

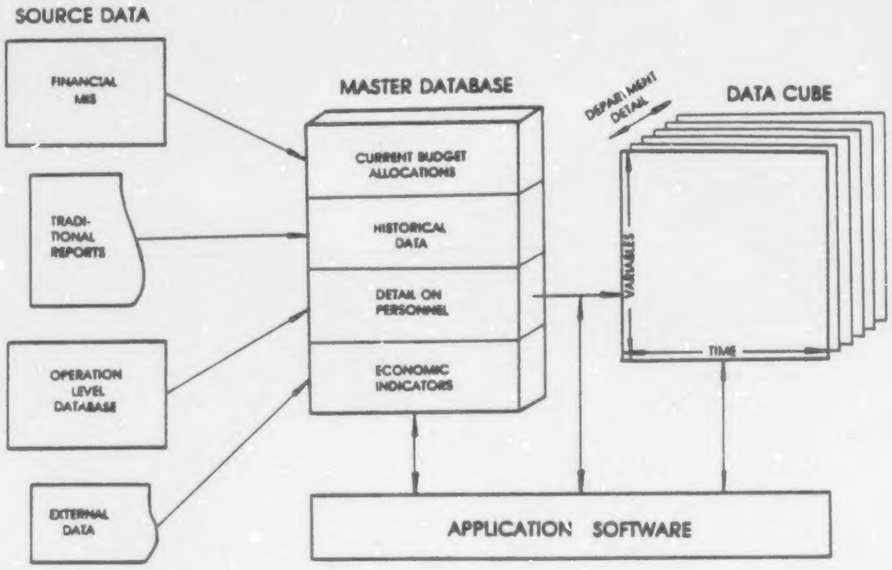
SOURCE DATA
FINANCIAL MIS
TRADI-TIONAL REPORTS
OPERATION LEVEL DATABASE
EXTERNAL DATA
MASTER DATABASE
CURRENT BUDGET ALLOCATIONS
HISTORICAL DATA
DETAIL ON PERSONNEL
ECONOMIC INDICATORS
DEPARTMENT DETAIL
DATA CUBE
VARIABLES
TIME
APPLICATION SOFTWARE

FIGURE 2
CONSTRUCTION OF THE EIS DATABASE

master database with information at the lowest possible level of detail and finally, creation of the executive data cube. Neither master database nor data cube remain static; both are updated on a continuing basis.

There were several dimensions which the database must cover: 1. current information concerning budget allocations, 2. the history of those allocations, 3. details concerning administrative services personnel and, 4. some measure of the external factors which influence the allocations and expenditures. Four sources were identified to provide such information.

For the current fiscal year, highly detailed information could be extracted from the financial information system the university had purchased several years ago. This system provides reports of the account, department, campus and university levels, but it does not have the capability to show more than one level at a time. In order to construct a picture of the administrative services budget we had to identify all accounts within the executive's span of control and to identify the lowest level of expense detail to include. Account detail and the disaggregated expense categories provide two dimensions in the database. Thus, the structure is flexible, allowing for future changes in data categories, for example, changes in organization structure or changes in definitions of major expense categories.

Historical information was not available in any computer file. For this information we identified the annual report submitted to the legislature and the Board of Higher Education. This document is representative of the traditional approach to budgeting and is produced from special reports and from information in the MIS discussed above. The information is reported by function, e.g. instruction, research, public service, student services, institutional support, etc. Expense information is only provided for the broad categories of personal services and expense and equipment (E&E). No further detail is provided. For most departments, however, the information for the last five years is accurate and is adequate for examination of trends and any needed extrapolation. The information system is expandable; as it matures, a greater level of detail will be incorporated. For example, we now have detailed data for FY83 and FY84.

The third component of the database is information concerning the people who work in the administrative service departments. The source of this information is an archaic transactional data processing system used for the university payroll and represents the only source for detailed information concerning university employees. We gain access to payroll data by submitting a request to the data processing department for an extract file from the master. The payroll system is not without it's individual quirks and problems. The extract file requires several stages of adjustment programs before accurate statistics can be generated. Information collected from this source includes variables such as employee classification, FTE, data of first hire, and salary information.

The fourth and last area is external data. In order to take into consideration the effect of exogenous factors which effect budget allocations and expenditures, inflation indices were constructed from monthly consumer prices reported by the Council of Economic Advisors. Algorithms built into the system allow adjustment for a calendar or fiscal year deflator and can convert the base year to the standard 1967 and 1972, to any year after 1977.

Data collected in the four areas discussed above were entered into four large VisiCalc files.[3] Once the master files were in place, extracts were made to produce the files that would become part of the executive's data cube. The essential information was condensed into a very limited and select set of key variables. Every effort was made to make all the extract files easy to access and manipulate. Everything is clearly identified with labels, built-in formulas provide totals for vertical and horizontal aggregations such as department total and expense category totals, and explanations are provided in the form of footnotes.

Development of the Budget Model

The content of the data cube is determined by the executive's needs for budget information. Similarly, the capabilities and aids built into the model were based on how we perceived the executive would use the system. In designing the system we considered the nature of the data, the available software, method of use and style of the executive, and training tools. In short, we had to individually tailor the system to meet the specific needs, style and temperament of the Vice Chancellor. The resulting system is composed of several parts: the budget files, training and directory tools, generated reports and analytics, and ad hoc analysis.

Initially, the Vice Chancellor planned to rely on the ability to view and print files only, in the traditional "read only" fashion. The many file variations were aimed at satisfying this requirement. As his sophistication increased, and the executive became more comfortable with VisiCalc, the ability to do his own analysis became more important. Eleven files were provided in all. First level files contained department totals for personal services and E&E and showed the bottom line totals for all units reporting to the executive. Subsequent derivations show the distribution of his budget across and within departments for different levels of aggregations. Other files show historical allocation patterns both in current and real dollars and can extrapolate trends based on estimates for future allocations under different scenarios. Finally, a file showing the personnel services and equipment and expense budget for each unit was used as the basic data in constructing a "what-if" module.

The what-if files, can be used to assign a percentage increment or decrement to any category or set of categories. The changes cause an entire new budget sheet to be generated including the aggregated dollar and percentage amount of all the changes. Using these modules, alternative budget options can be easily examined, facilitating the decision making process. The module gave the Vice Chancellor an opportunity to test the effects of both uniform budget changes in which each unit budget is altered by the same percentage, or variable budget changes in which different units are altered by different percentages. It also provided an opportunity to examine how reallocations can be made within the limits of a prespecified fixed total budget.

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[3] VisiCalc — an easy to use electronic spreadsheet package — is a registered trademark of Personal Software, Inc.

A simple VisiCalc tutorial and directory of system files was developed to assist the executive in using the system. The information is contained on a diskette that can be used alone or in conjunction with the component files. The tutorial steps through the basics of VisiCalc including how to load and save files, how to manipulate information contained in files, and how to print files using different available options. The directory, provides a succinct description of the contents of each file, describing the calculation of summaries and statistics, and provides the location (cell address) of critical parts of the file.

Although the emphasis in this section is on the technical aspects of the microcomputer based EIS, there are many parts of the system that remain in a more traditional mode. One such component is the production of paper reports. The project summary report serves to show a static picture of the budget at that point in time, provides a document for satisfying other reporting requirements of the university, gives more detailed documentation of the system, and illustrates some of the system's capabilities for analysis. However, one of the real values of the report is that it provides a reference guide for the executive and a transition from reliance on static, traditional reporting to the dynamic qualities of the EIS system. In short, it serves not to answer questions, but to indicate other questions which can be answered with the EIS and a few key strokes.

Graphics are a very important component of the system. Not only do they serve the obvious function of visually illustrating study results, but graphic presentations form an important component of the communication channel for decision support activities. A picture can show the executive at one glance if the analysis is "on the right track." Graphics command attention, they can illustrate various aspects of the budget picture internally or in relation to other parts of the organization or external environment, showing the current picture, what it looked like in the past and, what various alternate scenarios will make it look like in the future. For example, pie charts were used to illustrate the distribution of administrative services funds, trend graphs show the historical allocation of funds and the effect of inflation over time.

Personnel services is the largest component of the administrative services budget; over 80% of the funds not dedicated to utility bills are earmarked for salaries and wages. Because of the magnitude of this budget component, detail concerning the people who work in administrative departments forms an important part of the information system. This information is presently accessible only through the mainframe computer and a system of programs residing in a documented partitioned dataset (PDS). Statistics such as average salaries, headcount, retirement patterns, etc. can be generated by using members of the PDS. Graphics illustrating salary distribution are also produced.

The ability to perform ad hoc analysis is one of the major benefits of an EIS. The clear division of data and programs characteristic of mainframe computing does not exist; the system is not some mysterious black box which performs magic with the data. Rather, the executive can clearly see and understand the system structure. This understanding facilitates the transition to hands-on analysis. By accessing the information directly the Vice Chancellor found that he discovered new insights into his organization and could better define areas in which he needed additional information.

Although interaction of the executive and the information system is of primary importance, the role of the support group remains a critical part of the overall system. In our case, we serve not only as system developers (an on-going process), but also as staff support and the analytical arm of the Vice Chancellor's organization. In the final stages of the Doomsday Planning Budget we assumed responsibility for producing the final interface between the budget model and the doomsday report.

Conclusion of the Study

While the budget study was in progress, the Vice Chancellor for Administration engaged in negotiations with the Chancellor and the other two Vice Chancellors concerning how large a share of the decrement would be borne by Administrative Services. The computer displays, what-if module and hard copy tables and graphs were all used to support arguments and to clarify the need for funds. For the Vice Chancellor for Administration, a key gain was his ability to discredit the myth of huge gains in administrative services funding during the past several years. The data clearly show no real dollar gains in such funding. After long negotiations, a first order approximation to the Administrative Services decrement was set at roughly 5% of the controllable state allocation.

When the time came to determine exactly how the decrement would translate into cuts in service and reductions in staff, the Executive Information System became a support tool in a political process. The what-if module was used to compute the 5% across the board decrement for all support services units and to generate a budget report showing the decrement in each unit. A meeting of the unit directors was convened. Each director was asked to submit a budget statement showing how he or she would absorb the decrement to his or her unit, specifying what functions or service would be eliminated and what staff cuts would result. The key components of statements submitted by the directors were concatenated to the unit record in the microcomputer budget master file. A final summary report was produced showing the proposed changes in services and staff and the fiscal consequences. This report and a brief supporting narrative, written by Campus Planning, went forward as the major documents in the Vice Chancellor's response to the request for a Doomsday Planning Budget. The microcomputer based budget system had contributed substantially to the budget planning process.

SUMMARY

The successful integration of microcomputer support into the Doomsday Planning Budget exercise depended on more than hardware and software. It also depended on giving consideration to processes in place, to the people who have input into, and are affected by decisions, and most importantly to the individual decision making style and temperment of the executive. Further, our success was facilitated by providing learning tools for the executive and by paying close attention to communication techniques, including graphic presentations. These strategies helped the executive understand the information more rapidly and thoroughly, and assisted him in presenting persuasive arguments to his fellow decision makers.

The Office of Campus Planning occupies a position in the organization which was once unusual, but is now becoming quite common - we bridge the gap between data processing and the executive. In conclusion, to others who are assuming similar positions in their organizations we offer ten suggestions for success in their new roles:

1. Keep abreast of the current technological tools.
2. Know what data is available both internally and externally, and have the expertise and "clout" to access it.
3. Have expertise in creating and maintaining data bases.
4. Be skilled as an analyst, synthesizer and model builder.
5. Know the environment and the organization. Have the confidence of the executive and be part of the formal and informal communications network.
6. Be flexible, ready to change and adapt the system design.
7. Have sufficiently good communications skills to present the information in its most useful form.
8. Remember to provide learning tools for the decision makers.
9. Understand learning, problem solving and group behavior well enough to facilitate the integration of the information into the decision making process.
10. Recognize the value and role of information and rational decision making in environments that will always include collegial, bureaucratic and political decisions.

Inventory and Billing Systems for Multiple Users

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Abstract

Washington State University developed a comprehensive supplies inventory system and a generalized billing system with multiple users in mind. Currently, 14 campus service units are using these on-line database systems, and have realized better inventory management, improved customer service, and faster revenue return. Eliminating paper flow from these units to the central accounting office has greatly reduced accounting's workload. Now the benefits of these two systems have been extended to the service units' customers themselves. With video terminals, departments across campus can check inventory availability and current prices, place their own orders electronically, and receive next-day delivery of supplies.

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San Francisco, California

Inventory and Billing Systems for Multiple Users

Washington State University Database

In the fall of 1978, Washington State University initiated a plan to integrate administrative information processing using an online database approach. Work began to identify the data being processed within the university, either by automated or manual means. Administrative functions were analyzed and charted without regard for organizational boundaries. The result was a clear picture of data and activities to be integrated into a university information system.

Some of the functions studied in this process were already served by automated data processing. A few of these were online systems, but most were independent batch systems and near the end of their useful life. Many of the functions were handled completely by manual procedures without the benefit of automated processing. The strategy which was adopted to gain the most benefits in the shortest amount of time was to concentrate effort on the "data feeder" systems. That is, automate and integrate the areas which collected or prepared the data that was fed into central processing systems such as accounting or student records.[1]

Inventory and Billing Requirements

At this same time, an effort was undertaken to automate the inventory control and billing functions at the university's largest storeroom operation, Central Stores. Central Stores is a self-sustaining service center which purchases and warehouses office, laboratory, and hardware supplies. It serves the entire Washington State University campus and outlying units, as well as local governmental agencies and the nearby University of Idaho.

The Central Stores inventory was being processed entirely by hand. Items were removed from inventory and delivered to customers before the manual inventory records were updated. Prices and totals were written onto the multi-part order form and a copy forwarded to the central accounting office. There the forms were reviewed and coding corrections made. After key-entry and a preliminary batch-edit process, the transactions were ready for the accounting system. However, if errors had been detected, the transactions would wait for someone with the time to investigate. It may have been weeks later that the problem was resolved and the transactions processed through the accounting system. Then on the next monthly Budget Statement the customer departments first knew how much they had been charged for supplies, and on the following Budget Statement, Central Stores would see a credit for that revenue.

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[1] Jack Steingraber and Doug Kunkel, "An Integrated University On-Line/Data Base System: A Reality", Proceedings of the 1981 CAUSE National Conference, 1981, p. 227.

The Central Stores operation clearly performed a "data-feeder" function. And it was similar to other service centers which also fed interdepartmental transfer and accounts receivable transactions into the accounting system. There were also several other units on campus which kept specialized inventories and that had inventory control problems much the same as Central Stores. It was apparent that the inventory and billing systems needed by Central Stores were good candidates to be designed and integrated with the university database.

A Preliminary Requirements Study for automating the inventory and billing functions at Central Stores and other university units was done in the fall of 1978. Units that were interviewed included Central Stores, Duplicating and Mailing, Surplus Stores, Equipment Repair Service, Purchasing, Receiving and Delivery, Housing and Food Service, Physical Plant, Motor Pool, Accounts Payable, and General Accounting. The study results confirmed that several units could benefit from a comprehensive inventory system and additional units would benefit from a generalized billing system as well. A Cost/Savings/Benefit Analysis presented several alternatives for Central Stores, and it was decided to proceed with systems development using the main campus computer and the university database. With this approach, other service centers would be able to share in the use of the systems.

An Inventory Management System (AIMS)

The comprehensive supplies inventory control system developed for Central Stores is called AIMS, An Inventory Management System. Its major components include four online transaction processing functions, two online file maintenance functions, and two online inquires. These, along with other system components, are listed in Table 1. The online transaction processing functions are used daily, and allow database inventory records to accurately reflect inventory on the shelf. There are no batch transaction processors. Batch processing is limited to a monthly reconciliation procedure, printing of the catalog, and operational and management reporting.

The most frequently used online transaction is Sales Processing. It performs a billing function as well as processing inventory information. An initial data entry screen accepts the customer's requisition number to be billed, the date of the transaction (if not today), and messages or customer references for the picking/packing slip. This screen also provides links to two other database systems, the Project Management System and the Planned Maintenance System, which allow the posting of inventoried materials charges to both projects and pieces of equipment. After the initial data has been entered, a billing validation screen is returned. Then a repeating screen allows the entry of up to 10 inventory items at a time, requiring only the item number and quantity being sold. For each one of these screens used, a verification/error screen returns showing the results of those entries. The terminal operator has an opportunity to void any entry at this point. When the entries have been verified, inventory records are automatically posted, the customer's requisition balance is updated, and transactions are created for audit purposes and to feed into the accounting system. When the sale is complete, a picking/packing slip is automatically printed on the service center's online printer, and the order is filled.

Table 1. An Inventory Management System (AIMS).

Online Functions

Sales Processing
Receiving Report Processing
Physical Inventory Count Entry
Order Entry

Item Description File Maintenance
Supplies Inventory File Maintenance
Item Description File Inquiry
Supplies Inventory File Inquiry

Item Sales History Inquiry
Item Transaction List Inquiry
Order Group Average
Receiving Report Error Fix

Batch Reporting

Catalog Select, Sort, and Print
Inventory Exception Report
Inventory Monthly Reconciliation and Totals
Inventory Ordering Forms
Inventory Proof List
Inventory Valuation Report
Physical Inventory Forms
Shelf Labels
Transaction History Report

The other major online transaction processors function in a similar manner. An initial data entry screen accepts some general information, then a repeating screen allows the entry of up to 10 inventory items at a time. Verification/error information is returned, and the terminal operator may void any entry. When the entries have been verified, inventory records are posted, and audit transactions are generated.

Each of the transaction processors, however, has a different purpose. Receiving Report Processing is used to add more stock to the inventory. It calculates new prices for items based on the algorithm for that service center. Physical Inventory Count Entry adjusts the inventory when a physical count is taken and some discrepancies found. It accumulates the total dollar value of the shortage or overage, as well as generating the detail audit transactions. The Order Entry function is used when it is necessary to replenish inventory supplies. It collects information for an order attachment which is later printed online and forwarded to the Purchasing Office. There it is attached to a purchase order and sent to the vendor. One copy is kept at the inventory site to be used as a receiving report.

The two online maintenance functions and two online inquiries are used to add, change, or display information from two database files. One file, the Item Description File, contains general information about each inventory item. It has the detailed item description needed to print on an order attachment. It also has other purchasing information that will be used when an online purchasing system is implemented on the database. The second file is the Supplies File, which contains one record for each item in each service center's inventory. It should be noted that the quantity-on-hand or cost of an item in the Supplies File cannot be changed with the file maintenance program. Changes to those data elements are only made with the online transaction processors so that an adequate audit trail is kept.

The remaining online functions serve special purposes. The first inquiry is an Item Sales History, showing the monthly sales totals for an item over the past two years, with a three, six, and twelve month average for reorder purposes. The second inquiry is an Item Transaction List which displays the recent transactions for an item, including sales, receiving reports, and physical inventory counts. Order Group Average is used to average together the cost of a group of items in order to arrive at a common selling price, e.g., felt-tip pens, where new stock of some colors is received at a higher cost than old stock and would otherwise result in a higher selling price for those colors. The final online function, Receiving Report Error Fix, allows the back-out of a receiving report entered incorrectly which resulted in an error in price calculation.

Service Center Billing System

The generalized Service Center Billing System implemented for Central Stores is comprised of a single online transaction processing function, one online file maintenance function, one online file inquiry, and several special purpose online functions (see Table 2). Batch processing is limited to preparing transactions for the accounting system and printing operational and management reports.

The online transaction, Special Charge Processing, is used to bill any and all charges to customers. It handles charges for labor and benefits, equipment usage, subcontract work, and non-inventoried materials (note that inventoried materials are billed through Sales Processing in AIMS). The initial data entry screen is identical to the initial screen in Sales Processing. It also links to the database Project Management and Planned Maintenance Systems, posting charges to both projects and equipment. After a validation screen is returned, a repeating screen allows entry of the detail for each charge. Additional data elements on this screen provide a link to the Property Inventory System, accruing income to a piece of equipment when its use is billed out to a customer. A verification/error screen returns for the charge, and the terminal operator may void it at this time. All verified charges are reflected by an update of the customer's requisition balance, and transactions are created for the dual purpose of audit and feeding into the accounting system. When the charge processing is complete, a charge slip is automatically printed on the online printer, if the service center has chosen this option.

Table 2. Service Center Billing System.

Online Functions

Special Charge Processing

Requisition File Maintenance
Requisition File Inquiry

Special Charge Transaction List
Transaction File Look
Packing/Charge Slip Message
Requisition Change to New Fiscal Year
Requisition Fix to be Reopened

Batch Processing and Reporting

Daily Billing with Service Center Totals
Monthly Billing with Service Center Totals
Monthly Consolidated Invoices
Requisition List
Requisition Purge Report

The online file maintenance function is used to change data on the Requisition File which holds the billing information for each customer. If interdepartmental requisitions are set up with an initial dollar amount, then that amount is encumbered in the central accounting system. This encumbrance may be split among as many as 10 accounts numbers. (As expenditures are accrued to these accounts through Special Charge Processing or Sales Processing, corresponding amounts are liquidated from the encumbrance.) Additional funds may be entered at any time. Beside a dollars spent (or overspent) limit, the requisition may be restricted to a specific time period, to a single classification of expense, and/or to a limited number of named people who are authorized to do business. Any of these restrictions, as well as other informational or accounting data, may be changed with the file maintenance function. Similarly, all the restrictions, informational, and accounting data are displayed with the online inquiry function.

There are five special purpose online functions included in the billing system. The first is Special Charge Transaction List, an inquiry to the service center's special charge transaction records within a specified period of time. The second, Transaction File Look, presents more detailed information from transaction records. These can be selected by date created, date effective, requisition number charged, invoice number, item inventory number, or a single transaction's internal sequence number. The Packing/Charge Slip Message function allows a service center to include a standard message on all its printed slips, and to change that message whenever desired. The Requisition Change to New Fiscal Year function is used to renew a requisition for another year with a new balance. The final function, Requisition Fix to be Reopened, is used to clear any previous overexpenditure on a closed requisition that is to be reopened with additional funds.

The batch processing and reporting functions of the Service Center Billing System warrant some explanation also. Transactions that result from Special Charge Processing and Sales Processing are prepared daily for input to the central accounting system. These transactions represent encumbrances, liquidations of encumbrances, accruals of expense, and accounts receivable charges. Totals are accumulated by online function and transaction type for each service center, and are printed either at the service center's online printer or at a central site for distribution. Monthly billing procedures include the reversal of accruals and preparation of the actual disbursements, with a reconciliation of transactions to the Requisition File and the printing of totals for each service center. Monthly invoices recap all detail transactions for the month on each requisition that the customer has with any of the service centers participating in the billing system.

Several references have been made to multiple service centers within the Service Center Billing System. It is apparent that the original plan of developing a system for Central Stores and implementing it for other service units has been successful. New users have been added to both the inventory and billing systems with very few modifications. There are currently 14 university service centers which use one or both of these systems. Their names and principle service functions are listed in Table 3.

Table 3. Service Center Billing System Users.

Service Center	Function
*Alcohol Stores	Laboratory alcohol supplies
*Central Stores	Office, laboratory, hardware supplies
College of Engineering	Photo, machine, design shops
College of Pharmacy	Pharmaceutical supplies
Heavy Equipment	Heavy equipment rental and repair
Instructional Media Services	Media production, rental, repair
Mailing Services	Mailing and postage
Motor Pool	Fleet vehicles rental and repair
Physical Plant	Maintenance and construction
*Physical Plant Storeroom	Construction, maintenance supplies
Publications and Printing	Duplicating and printing services
Technical Services	Electronics, glass, instrument, graphics shops
University Computing Services	Automated administrative systems
Vivarium	Research animal care

*also users of An Inventory Management System.

System Benefits

The university has gained a great deal from An Inventory Management System and the Service Center Billing System. Design of the systems to function for multiple users has been successful beyond expectations. Use of the central database has allowed integration with more recently developed systems, notably Project Management, Planned Maintenance, and Property Inventory. A total of 42 specific benefits were listed in the Cost/Savings/Benefit Analysis document, and nearly all of them have been realized.

Inventory system users have better inventory management with accurate and timely inquiries and reports. Detailed data on each item and item sales history is available online. Audit transactions provide sales, receipts, overages, and shortages for every item. Automated re-order points and ordering tools improve ordering procedures and reduce the number of items out of stock. The standardized selling price calculation along with consistency in other procedures increase employee efficiency. Online inquiries replace going out into the warehouse to answer questions and to check on items. The inventory system eliminates the need for a service center to spend weeks in assembling and printing a catalog, or days being closed for business to take a physical inventory, or hours preparing month-end financial reports.

For billing system users, the benefits are equally valuable. The service center is able to provide more monitoring and control functions for its customers. Non-university customers are billed as easily as university departments. Special indicators allow tracking and reconciliation of cash sales. Priced packing/charge slips, monthly detailed invoices, and prompt billing through the central accounting system improve service to all customers. The customer always knows how much has been charged, and the service center knows when it will receive credit for the revenue. Information is available to both of them for a more accurate financial picture.

The fact that the billing for 14 service centers is done automatically means a drastic reduction in workload in the central accounting area. There is no longer a need for handling paper, editing, totaling, adding account codes, batching for data-entry, running pre-edit checks, and correcting errors. All these functions are done online and in the daily billing process. Recent estimates put the reduction in workload at 70% of the interdepartmental requisition processing. As a result, the central accounting area is actively pursuing its own use of the billing system to process the remaining interdepartmental workload.

Direct Customer Orders

Now there is an extension of the inventory and billing systems that affords significant additional benefits. That is putting these systems into the hands of the end users, the customer departments themselves! Because these systems are integrated into the central university database, departments with video terminals are able to check the Central Stores inventory and place their own orders for supplies electronically.

There are two basic functions which support the departments in placing direct orders. One is a limited inquiry capability which accepts an item number and displays back the description of the item, selling unit(s) and price(s), quantity on hand, quantity on order from the vendor, and date of the last vendor order. The second function is Sales Processing. With the added restrictions of accessing only appropriate requisitions and of disallowing price adjustments and credits, the customer uses the same Sales Processing function that would be used if the order were mailed to Central Stores and entered into the system there.

The benefits of direct orders are a gain in time and efficiency. The customer spends about the same amount of time at a terminal as would have been spent typing the order. But now the availability (or backorder) of stock items is known when the order is placed. The cost for the order and the new requisition balance are also immediately available. The picking/packing slip automatically prints at Central Stores identifying which terminal originated the order, and the order is filled. The electronic transmittal alone cuts out a two to four day delay caused by sending the order through the campus mail system. The result is a dramatic improvement in service, from a four or five day wait to next-day delivery!

Departments currently ordering directly from Central Stores include all the service centers using the Service Center Billing System, plus departments in the College of Agriculture, the Office of Systems and Computing, and nearly all of the central administrative offices. As the terminal network expands rapidly across the campus, more departments will be able to take advantage of this direct ordering capability. The unique multi-user system design and the central integrated database combine to allow the benefits of both An Inventory Management System and the Service Center Billing System to be extended to all university departments.

Progressive Planned Maintenance

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Abstract

The Physical Plant Department at Washington State University had classic equipment maintenance problems. Management was unable to identify, schedule, or plan maintenance effectively; inefficient use of maintenance staff prevailed. Maintenance reports lacked sufficient detail, and were cumbersome and time consuming to prepare. The Planned Maintenance System implemented at WSU uniquely integrates functions of equipment inventory, scheduling, time reporting, project management, materials inventory, and billing. Management now has immediate access to equipment data, maintenance status and costs. Staff requirements are readily defined through standardized task assignments. Schedules, budget requirements, and resource adjustments are determined with the aid of detailed, up-to-date reports.

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December 11 - 14, 1983
San Francisco, California

INTRODUCTION

The Physical Plant Department at Washington State University, Pullman, maintains facilities, grounds and equipment for a large institution situated in a rural community. A long term goal to improve the efficiency and effectiveness of the large Physical Plant operation was realized when the Physical Plant Department and University Computing Services designed and developed a system for planned maintenance of equipment using the integrated university database. Equipment for the purposes of this application is defined as fixed assets attached to the building at construction. University Computing Services, the administrative data processing unit at Washington State University, maintains a university-wide database system on an AMDAHL 470/V8. The database utilizes the ADABAS database management system. Programming for the Planned Maintenance System for equipment is in the NATURAL and COBOL programming languages.

BACKGROUND

Prior to 1980, Washington State University lacked a completed inventory of equipment. Regular, scheduled maintenance was impossible because neither the identity nor location of the equipment was available. Maintenance of equipment was done primarily when a breakdown occurred or a potential problem was otherwise discovered. The maintenance staff was alternately very busy or faced with idle time. When maintenance was performed there was no way to assure the same work was done on each piece of equipment for the same problem or service. Lack of parts caused frequent service delays because there was no ability to coordinate parts requirements. Although repair and emergency service costs were high, the Physical Plant management lacked the information to analyze the source of the costs. Maintenance budget requests to correct the situation were difficult to justify. However, the university administration recognized the long term necessity of adequate equipment maintenance and a Planned Maintenance System development project was approved.

SYSTEM DESIGN

The Planned Maintenance System for equipment was designed to integrate the functions of scheduling, time reporting, project management, stores inventory, and billing. A diagram of system relationships is shown on Figure 1. The systems for stores inventory and billing were already in place at Washington State University but the systems for time reporting and project management had to be developed in parallel with the system for equipment maintenance.

Equipment Maintenance, Scheduling, and Instructions

The first task was to identify and classify the type of equipment for inventory. These classifications were assigned a number which corresponds to the item numbers in the stores inventory system. A list of the equipment inventory classifications is shown on Figure 2. In February, 1980, a

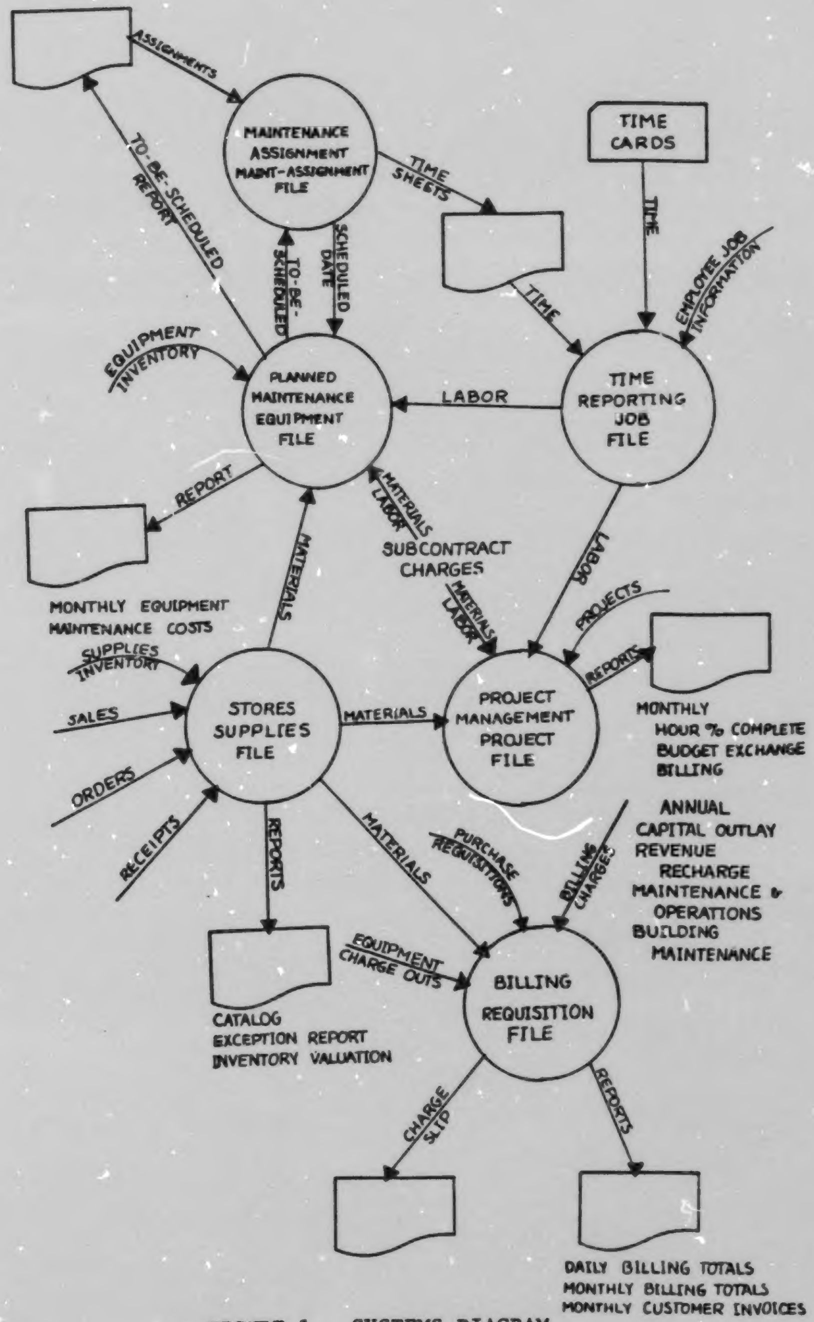
ASSIGNMENTS
MAINTENANCE ASSIGNMENT MAINT-ASSIGNMENT FILE
TO-BE-SCHEDULED REPORT
TIME SHEETS
TIME CARDS
TIME
TO-BE-SCHEDULED
SCHEDULED DATE
TIME
EMPLOYEE JOB INFORMATION
EQUIPMENT INVENTORY
PLANNED MAINTENANCE EQUIPMENT FILE
LABOR
TIME REPORTING JOB FILE
REPORT
MATERIALS LABOR
MONTHLY EQUIPMENT MAINTENANCE COSTS
MATERIALS
SUBCONTRACT CHARGES
MATERIALS LABOR
LABOR
PROJECTS
REPORTS
SUPPLIES INVENTORY
SALES
STORES SUPPLIES FILE
MATERIALS
PROJECT MANAGEMENT PROJECT FILE
MONTHLY
HOUR % COMPLETE
BUDGET EXCHANGE
BILLING
ORDERS
RECEIPTS
REPORTS
MATERIALS
PURCHASE REQUISITIONS
BILLING CHARGES
ANNUAL
CAPITAL OUTLAY
REVENUE
RECHARGE
MAINTENANCE & OPERATIONS
BUILDING MAINTENANCE
EQUIPMENT CHARGE OUTS
BILLING REQUISITION FILE
CATALOG
EXCEPTION REPORT
INVENTORY VALUATION
CHARGE SLIP
REPORTS
DAILY BILLING TOTALS
MONTHLY BILLING TOTALS
MONTHLY CUSTOMER INVOICES

FIGURE 1. SYSTEMS DIAGRAM

EQUIPMENT INVENTORY CLASSIFICATIONS

MAINTAINABLE EQUIPMENT

- Aftercooler
- Air Compressor
- Air Damper
- Air Filter
- Aisle/Stair Light
- Backflow Preventer
- Chiller
- Clock
- Condensate Meter
- Condensate Pump
- Control Valve
- Converter
- Cooling Coil
- Cooling Tower
- Damper Operator
- Deionized Tank Set
- Distribution Panelboard
- Door Closer
- Door Lockset
- Drying Cabinet
- Electric Steam Generator
- Electric Water Cooler
- Emergency Eye Wash
- Emergency Generator
- Evaporative Cooler
- Exhaust Fan
- Exit Device
- Exit/Directional Signs
- Expansion Tank
- Extinguisher System CO_2
- Faucet
- Fire Alarm System
- Fire Curtain
- Fire Extinguisher
- Fire Sprinkler System
- Fire Standpipe
- Fixed Furniture
- Fume Hood
- Furnace
- Gate/Globe Valve
- Halon Fire System
- Heating Coil
- Hose Rack
- Hot Water Heater
- HVAC Mech. Room Unit
- Hydrant (Fire)
- Lab Sink
- Lab Table Outlet
- Lavatory Fixture
- Light Fixture
- Low Pressure Boiler
- Main Distribution Panel
- Motor Control Center
- Pipe Strainer
- Power Transformer
- Primary Switchgear
- Pump
- Purge System
- Quality Control Light
- Receiver-Controller
- Refrigeration Compressor
- Resisivity Monitor
- Safety Shower
- Sash Hardware
- Smoke Hatch
- Steam Reducing Valve
- Sump Pump
- Supply Fan
- Thermal Recovery Unit
- Thermostat
- Urinal
- Water Closet
- Water Softener
- Vacuum Pump

COMPONENTS

- Air Filter Gauge
- Ballast
- Belt
- Bearing
- Chemical Feed Pump
- Chemical Monitor
- Component Fan
- Component Pump
- Compressor
- Condensor
- Control Valve
- Electro-Pneumatic Controller
- Engine
- Evaporation Valve
- Evaporator
- Fan Sheave
- Filter (Air)
- Flame Fail Device
- Float Switch
- Flow Control Valve
- Flush Valve
- Generator
- High Pressure Switch
- Low Pressure Switch
- Mixing Box
- Motor
- Motor Sheave
- Oil Safety Switch
- Pressure Reducing Valve
- Recirculating Pump
- Relief Safety Valve
- Static Pressure Regulator
- Steam Trap
- Transfer Switch
- Unfired Pressure Vessel
- Volume/Control Terminal Unit
- Water Regulating Valve

FIGURE 2. MAINTENANCE CLASSIFICATIONS

crew of seven people started taking a physical inventory of equipment in 120 buildings. It took almost a year to inventory approximately 75,000 items. Of these, only 30,000 items were determined to be maintainable items. Components of maintainable equipment were included for identification, performance tracking and parts requirements. Some items have been grouped for maintenance but retain individual identity for location and parts tracking. Each maintainable equipment record contains a project number, recommended maintenance services, history of maintenance labor hours and costs, and history of maintenance materials costs. A full description of the equipment is provided for parts requirements, and a specific location is designated.

After the inventory classifications were established and while the inventory was taken, the types of maintenance for each classification were analyzed. Manufacturer warranty requirements and maintenance recommendations were used to develop a set of standardized maintenance instructions for each equipment classification. Each maintenance instruction set specifies a frequency, shown on Figure 6, a task time, a recommended craft and a maintenance supervisory area. Maintenance supervisory areas and crafts are shown on Figure 3. The maintenance instruction set number is the key to the specific maintenance service on the equipment record. Each equipment classification may have up to ten different maintenance services. A total of 310 different maintenance instructions are required to maintain 156 different types of equipment representing 30,000 inventory items. The online system for equipment, developed in the summer of 1981, automatically attaches all appropriate maintenance services to the maintainable equipment record when it enters the system. The maintenance due dates are assigned separately.

MAINTENANCE SUPERVISORY AREAS	MAINTENANCE CRAFTS
Carpenter Shop	Carpenter
Controls Shop	Control Technician
Electrical Shop	Electrician
Electronics Shop	Electronic Technician
Janitor Shop	Janitor
Life Safety Shop	Life Safety Technician
Machine Shop	Machine Mechanic
Maintenance Mechanics Shop	Maintenance Mechanic
	Fan Balancer
Plumbing Shop	Plumber
Refrigeration Shop	Refrigeration Mechanic
Water Treatment Shop	Water Treatment Specialist

FIGURE 3. SUPERVISORY AREAS AND CRAFTS

Time Reporting

The maintenance staff was accustomed to reporting time daily by hours and fractions of hours. The time was reported against a project or work order as regular time or overtime. In order to post hours and cost to the equipment record, the Planned Maintenance System required an equipment inventory number and type of maintenance to also be reported. An online system for time reporting was developed and pay rates were placed in the employee database keyed by social security number. Hours, reported by employee, are converted to cost using the individual's pay rate, in order to post equipment and project records.

Project Management

The Physical Plant Department used a manual bookkeeping system to account for work units and cost centers. An online system for project management was developed in the Spring of 1981. In addition to maintenance projects, the system tracks costs for construction work orders and overhead accounts. Costs for facility maintenance as well as equipment maintenance are posted to maintenance projects. The system was designed to post projects with labor hours and costs from the time reporting system, materials costs from the stores inventory system, and subcontract charges from the billing or stores inventory systems.

Stores Inventory and Billing

A physical inventory of supplies and parts in the Physical Plant storeroom was taken in the Spring of 1981. Approximately 12,000 items in the storeroom were inventoried and coordinated in the database with items already in the stores inventory system. Modifications were made to existing inventory and billing programs to accommodate equipment maintenance, equipment charges, labor costs, and project management. Three online COBOL subroutines were developed to post equipment records and projects. These subroutines are accessed from the existing inventory and billing systems and from the new time reporting system.

IMPLEMENTATION

The maintenance instructions were placed in the university database in March, 1981. The equipment inventory was placed in the database in May, 1981, with the appropriate maintenance instruction set keys for each piece of inventory. In the summer of 1981 the modified stores inventory and billing systems, and the new time reporting and project management systems were implemented.

An analysis was made of the time required to maintain equipment in 19 buildings to determine the number of employees to commit to planned maintenance. Physical Plant management decided to implement planned maintenance in the 19 buildings and dedicated a staff of 18 to this task.

These buildings had 12,000 pieces of maintainable equipment and although the Physical Plant Department had the ability to assign maintenance dates to specific services it would have taken an inordinate amount of time to assign the dates manually. Critical to the success of the system was finding a means to assign the first maintenance dates automatically.

An algorithm was developed by which a first maintenance date was assigned to each maintainable equipment record. A date was assigned to the maintenance service of the least frequency, e.g. five years, and the other services were projected on the basis of the first date. Maintenance task times for all services were projected for the five year period. A five year, 260 week table of the number of assignable (available) staff hours committed to planned maintenance was built, taking holidays into consideration. Other elements in the table were hours already assigned, and a date for the week. Dates were assigned to maintenance services when the task time plus hours assigned did not exceed assignable hours. Other services were projected by adding task time of the service to assigned hours. The objective was to avoid overassignment of work which could have resulted in distorted deferred maintenance figures from the outset and an unmanageable workload. The first maintenance dates were assigned in February, 1982, and the first planned maintenance was performed in March, 1982.

HOW IT WORKS

Each maintenance area supervisor receives a weekly report of equipment maintenance due by building. A sample of this report is shown on Figure 4. This report reflects what is due two weeks in advance, although the date period is flexible. Maintenance services which have already been scheduled but not yet completed, also appear on this report, along with the scheduled date. The supervisor assigns the work to specific employees, taking into consideration the task times. The assignments are entered at the terminal and can be revised until the time sheet is printed. When the time sheet is printed, a scheduled date for the maintenance service is recorded on the equipment record. The specific maintenance instructions to do the work assigned are printed, along with the time sheets. A sample time sheet and maintenance instructions are shown on Figure 5. The Physical Plant Department prints time sheets weekly, although the system allows printing daily if necessary.

The maintenance staff uses the time sheet to locate the equipment and to record time when the work is performed. The inventory number on the time sheet may be used to purchase parts or materials from the storeroom for a specific piece of equipment. The cost of repair or maintenance materials is posted directly to the equipment record at the same time the storeroom inventory is updated.

The data entry staff enters the time, inventory number, and maintenance service key, from the time sheet. A project number is also required if not pre-printed on the time sheet. The time reporting system converts the hours to cost on the basis of individual pay rates. Both the hours and the cost

Date 11/18/83 TO-BE-SCHEDULED REPORT LIFE SAFETY DIVISION Page 114
WEEK ENDING 12/09/83

LINE	ASSIGN	INVN-NO	ROOM	LOCATION	PM	FREQ	TIME	UNITS	DUE	SCHED
	THOMPSON HALL									
	FIRE ALARM SYS									
2323	-----	25530100	0014B		1	A	3.00		10/21/83	* 11/18/83
	HOSE RACKS									
2324	-----	25536000	0300S		1	A	.20		12/01/83	
2325	-----	25537100	0200S		1	A	.40	2	12/01/83	
2326	-----	25539300	0100	WEST	1	A	.20		12/08/83	
	FIRE SPRINK SYS									
2327	-----	25531200	0022A		1	A	12.00		12/08/83	
2328	-----	25532300	0223G		2	A	14.00		12/08/83	
2329	-----	25717600	0422		2	M	.50		12/08/83	
	BRYAN HALL									
	FIRE ALARM SYS									
2330	-----	25714300	011B	OUTR WALL	2	A	6.00		11/15/83	11/18/83

FIGURE 4. TO-BE-SCHEDULED REPORT

TIME SHEET

LAST NAME FIRST EMPLOYEE NO MO DA YR 11/18/83 D6 1840

HRS	W.O. NO.	EQUIPMENT	TYPE	SET	INC			
----	820747-1	29385600	M	133		REFRG COMPRESSOR	JSN HL	0401
----	820747-1	29390400	M	133		REFRG COMPRESSOR	JSN HL	0352C
----	820747-1	29391500	M	133		REFRG COMPRESSOR AIR COMPRESSOR	JSN HL	0405
----	820747-1	29403000	M	133		REFRG COMPRESSOR COOLER RM 70	JSN HL	B0001
----	820747-1	71165300	M	133		REFRG COMPRESSOR	JSN HL	0170

INSTRUCTION SET

LAST NAME FIRST EMPLOYEE NO MO DA YR 11/18/83 D6 1840

INSTRUCTION SET 133

REFRIGERATION COMPRESSOR.
CHECK OIL LEVEL IN COMPRESSOR THROUGH SIGHT GLASS.
BE SURE IT COVERS HALF OF GLASS WHEN RUNNING.
CHECK OIL PRESSURE IN POSITIVE PRESSURE SYSTEMS.
BE SURE IT READS BETWEEN 50 AND 70 LBS. ABOVE SUCTION PRESSURE.
CHECK FOR PROPER REFRIGERANT FLOW AND MOISTURE.
FLOW SHOULD BE CLEAR WITH NO BUBBLES.
CHECK HIGH AND LOW PRESSURE GAUGES FOR CORRECT READINGS.
REPLACE ANY GAUGES FOUND TO BE DEFECTIVE.
INSPECT ENTIRE SYSTEM FOR UNUSUAL CONDITIONS.

FIGURE 5. TIME SHEET AND INSTRUCTIONS

for maintaining a piece of equipment are posted directly to the equipment record for a specific service, and to the building maintenance project.

The service frequency hierarchy, shown on Figure 6, provides for the least frequent service to include and replace the more frequent services. When regular maintenance is posted the date the next maintenance is due is automatically computed and the dates of other services due are synchronized using the frequency interval days. Adjustment of the dates avoids, for example, having a monthly maintenance performed a week after a quarterly or annual service. Startup and shutdown services are seasonal and therefore assigned the same date each year. A next service date is never assigned automatically for on command services.

FREQUENCY HIERARCHY	INTERVAL DAYS
5 year	1825
3 year	1095
2 year	730
Annual	365
Semiannual	183
Quarterly	92
Monthly	31
Weekly	7
FREQUENCY NOT SUBJECT TO HIERARCHY	
Startup	365
Shutdown	365
On Command	NONE

FIGURE 6. MAINTENANCE FREQUENCY

An exception report provides Physical Plant management with a list of all maintenance two weeks overdue. When a maintenance is overdue, a decision can be made to change the maintenance due date. This slippage of the date is recorded on the equipment record for the specific maintenance history.

Monthly reports provide management with maintenance costs by building and supervisory area. The costs are detailed by regular maintenance, repairs, and emergency, unplanned services. These reports, together with annual reports from the project management system, provide management with the necessary information to define staff and budget requirements.

BENEFITS

In the two years since the Planned Maintenance System for equipment was implemented, the benefits sought have been realized. Physical Plant management and staff have immediate access to pertinent information concerning equipment description, including components, and maintenance activity from the time the program was introduced. Decisions regarding replacement or repair of equipment are easier to make.

Efficient use of the maintenance staff is possible. Supervisors now plan the maintenance workload ahead of time and are reasonably certain of the requirements. Standardized maintenance tasks provide the supervisor with known task times making efficient scheduling of staff possible. The necessary parts or supplies for equipment service can be purchased ahead of time instead of using valuable labor allocations to make trips back and forth to the storeroom.

The number of emergency repairs has decreased significantly as more equipment is given proper maintenance through the Planned Maintenance System. Cost center and staff projections, normally required during the budgeting process, are available using the data elements established in the various database files. Statistical information, never available by any accurate measure in the past, is now easily accessed through a computer terminal.

The most important benefit to management the Planned Maintenance System has provided, however, is the improvement in morale of the maintenance staff. Mechanics and craft people now know their workload is identified and the information resulting from their work is being used in a meaningful way.

FUTURE APPLICATIONS

The Planned Maintenance System at Washington State University was designed and developed with continuing enhancement and expansion from an established database as a precise objective. The data elements to include motor pool vehicles in the Planned Maintenance System were included in the original development project. Vehicle maintenance requirements will very soon be identified in the Planned Maintenance System. Work has already begun to include structural maintenance such as roofs, decks, exteriors and interior wall upkeep into the Planned Maintenance program. The capability of a complete facilities maintenance system now exists. Budget cuts have resulted in a significant backlog of facilities maintenance. This backlog will be entered into the database and maintenance dates assigned. Deferred maintenance will be defined by default.

The versatility and flexibility of the system have provided Physical Plant administrators with the tools they have needed and wanted for well over a decade. Administrators continue to discover new ways to use and exploit the information provided in the database.

COMPUTING LITERACY FOR EDUCATIONAL ADMINISTRATORS

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Within the last five years, the development of computing literacy for faculty and students has been one of the more urgent concerns within educational institutions. Although there is no single definition of "computing literacy", many groups have developed a working definition of the term so that programs of computing literacy could be developed and implemented. The interest in computing literacy can be measured in several ways: by the number of schools with programs in this area; by the number of schools requiring some coursework in computing; and by the number of schools requiring that students acquire and/or have access to a "personal" microcomputer.

Computing may be used in any or all of the following areas within an educational institution: instruction; research; educational administration. The first two areas involve faculty, students, and researchers. The latter involves the educational administrator. While all three user groups are, or will be, involved in integrating computing into their daily professional lives, the existing computing literacy programs have been directed primarily to faculty and students. The educational administrator is often the "forgotten man" in computing literacy programs.

Iona College has been actively developing a program of computing literacy over the last four years. Beginning with the 1983-84 academic year, all students must satisfy a computing literacy requirement as part of the core curriculum. In order to implement such a program, much work was done to develop a computing literacy definition and curriculum. Faculty development has been underway so that faculty outside the field of computer science may begin to understand how computing relates to their discipline and how it may be integrated into their coursework.

Computing literacy for educational administrators is the most recently addressed component of the computing literacy program. This paper will define this new area of computer literacy and discuss the experiences gained over the past year in testing the curriculum and the delivery mechanism. The results of this effort (both the successes and the concerns) will be described as well as future directions for the program.

COMPUTING LITERACY FOR EDUCATIONAL ADMINISTRATORS

Introduction

Iona College is a medium-size liberal arts institution located in New Rochelle, New York. The College educates more than 6,000 students annually in degree programs at the undergraduate and graduate levels. Many of its students are first generation college students who wish to combine higher education and career preparation. Understanding these needs, Iona has traditionally attempted to blend a liberal arts education with the ability to find professional positions upon graduation.

Iona College has made a commitment to computing that is consonent with its liberal arts philosophy. It provides all students with a fundamental understanding of computing. It provides students seeking a computer and information science specialization with a variety of degree programs.

Computing Curricula

The College currently offers five undergraduate and five graduate degree programs in computer and information science.

- B.S. degree
  - Computer Science
  - Decision Science
  - Computer Engineering
  - Data Processing
- B.A. degree
  - Computer Information Science
- M.S. degree
  - Computer Science
  - Educational Computing
  - Mathematics and Computers
- M.B.A. degree
  - Management Information Systems
  - Management Systems and Science

Computing Literacy at Iona College: A Historical Perspective

By 1979, the growing importance of technology convinced the College that computing should play a major part in its curriculum. In 1979, computing was an option within the science area of the core curriculum. Arts and Science students could study computer science as an elective. Business students were required to complete six credits in computer science as part of the Business core.

The Science and Technology Project, begun in 1979, studied alternatives for implementing computing as a requirement for all undergraduate students. This project led to the implementation of the computer literacy requirement in 1983.

The following are some of the more significant activities during the period from 1979-1983:

- 1979 - Establishment of a Science and Technology Committee to study alternatives for implementing computing and science technology as part of the core curriculum.
- 1980 - "Computer Literacy: A Report to the Science Development Committee".
- 1981-82 - Pilot test of a computing literacy curriculum.
- 1981 - Establishment of a computing literacy program for faculty.
- 1982 - Establishment of a computing literacy program for administrators
- 1983 - Computing literacy requirement as part of the undergraduate core curriculum.

Computing Facilities

The College has a well-established and highly-developed central computing facility to support the administrative and academic users. The central facilities have been the primary delivery mechanism for providing end user computing until 1982. Formal microcomputer facilities were introduced in 1982 and substantially expanded in 1983.

The academic users have access to an IBM 4341 Group II system. There are 150 terminals available in student laboratories. The academic users are supported by the MUSIC (McGill University System for Interactive Computing) and VM/CMS operating systems. The majority of the academic systems run under MUSIC.

An IBM 370/135 with 48 terminals supports the administrative systems and users. The 370/135 will be replaced by an IBM 4341 system in December 1983; an IBM 43x1 is scheduled for installation in 1984.

There are 125 IBM Personal Computers in student laboratories and departmental and administrative offices. There are an additional 75 microcomputers (APPLEs, PETs, Tektronix, etc.) throughout the campus.

Software Resources

The extensive computing facilities (both mainframe and microcomputer) permit the Computing Center to provide its users with a wide range of application systems and programming languages.

Some of the more heavily used application systems available to users are:

- Word/text processing: MUSIC/SCRIPT; EasyWriter; WordStar
- Electronic worksheets: VisiCalc; 1-2-3; Iona AESOP (Advanced Electronic Spreadsheet Oriented Package)
- Database systems: dBASE II; Iona DATABASE
- Data Analysis: SPSS; MUSIC STATPAK

Some of the more heavily used programming languages are: PL/I (and PL/C); BASIC; COBOL (and WATBOL); FORTRAN (and WATFIV); PASCAL; Assembler Language.

Computing Literacy: A Pre-1980 Definition

One of the tasks of the 1979 Computing Literacy Project was to develop a definition of computing literacy that would promote an understanding of computers and their uses. The approach taken was to express literacy in terms of general competencies as well as specific computer skills. Since the program was being developed primarily for individuals outside of computing, it was more helpful to define literacy as a series of universal and subject-specific competencies which could be mapped to more specific computing objectives.

The universal competencies identified were:

- Knowledge of the history and uses of computing
- Knowledge of the types of problems amenable to computer solution
- Knowledge of the types of problems not currently amenable to computer solution
- The ability to read/write introductory computer programs
- Knowledge of the moral or human-impact issues relating to the societal use of computers

In addition, the following subject-specific competencies were identified:

- The ability to use and evaluate the computer as a problem-solving tool for discipline- or level-specific tasks
- Experience in using games and simulations for broader learning.

The Computing Literacy Project focused on defining computing literacy and formulating an implementation plan. Although the first phase was to implement a literacy program for the students, the objective was to produce a definition of computing literacy that would be valid across the academic community (faculty, students, administrators, staff).

Given the wide variety of user backgrounds and interests, defining computer literacy as a series of levels appeared to have merit. Computing literacy was defined in terms of a "minimum competency" which could be attained at Level 4. It was anticipated that, with a series of increasing skill levels, users would progress to the level that would best meet their needs to use computing on an on-going basis.

The "Computer Literacy Report" identified seven literacy levels:

- Level 1
  - Establish and terminate communications with a computing system
  - Intitiate execution of some action causing computer to perform a task
- Level 2
  - Use programs and/or systems that require decision-making during execution
- Level 3
  - Understand the use of computers in modern society
  - Knowledge of function and uses of computer
  - Understand where and how to apply computing to situations
  - Understand societal and technological impact of computing
- Level 4
  - Use computing to solve a problem in one's own field
  - Write introductory programs for problem solving
- Level 5
  - Develop programs in standard high-level programming languages
- Levels 6-7
  - Perform as a computing professional

Computing Literacy: A Definition for the 1980s

The two year pilot test of the computing literacy curriculum revealed the following limitations in the original definition:

- Some levels were too narrow to warrant individual treatment
- Some levels were too broad and must be subdivided
- Some levels should be re-arranged to correspond to the natural progression of the users' skills
- Some issues were not addressed by any of the levels
- Problem solving techniques should be emphasized in conjunction with hands-on experience
- Application systems should be emphasized for users outside of computing
- Programming should not be emphasized for users outside of computing

The identification of the levels and their contents were modified in 1983 to address the above concerns. In the revised structure, "minimum competency" is reached at Level 5. The revised level structure is currently being pilot tested.

- Level 1
  - Understand the use of computers in modern society
  - Understand societal, ethical and technological impact of computing
- Level 2
  - Level 1 literacy
    and
  - Knowledge of function and uses of computer
  - Understand where to apply computing to situations
  - Understand how to apply computing to situations
- Level 3
  - Level 2 literacy
    and
  - Understand the role of data within application systems
  - Understand the relationships that data has to each other and to the application systems
  - Understand the importance of valid data
  - Understand the consequences of invalid data
  - Understand the value of data within information systems
  - Understand the costs (gathering, entering, and storing) of data within information systems
- Level 4
  - Level 3 literacy
    and
  - Establish and terminate communications with a computing system
  - Intitiate execution of some action causing computer to perform a task
  - Use programs and/or systems that require decision-making during execution
- Level 5
  - Level 4 literacy
    and
  - Use computing to solve a problem in one's own field
  - Use application systems for problem solving
- Level 6
  - Level 5 literacy
    and
  - Read/write introductory programs in a standard high-level programming language
- Level 7
  - Level 6 literacy
    and
  - Solve a problem in one's own field by writing an application program in a standard high-level programming language
- Levels 8-9
  - Level 7 literacy
    and
  - Perform as a computing professional

Implementing a Computer Literacy Program for Administators

By 1982, computing literacy programs were in place for students and faculty. Students could enroll in computing literacy courses. Faculty could attend literacy seminars designed assist them in integrating computing into existing, non-computing curricula. The next phase was to expand this program to address the administrators' needs.

To implement and administer a computer literacy program for administrators, the Computing Center:

- Expanded its existing computing literacy program
- Developed the teacher and student instructional materials
- Promoted and publicized the program
- Taught the seminars
- Evaluated the curriculum and the program format

Funding Computing Literacy Programs

The Computing Center viewed the literacy program as a service it offered to the College community. The seminars were free of charge to College personnel. The costs of developing and offering the seminars and creating and publishing the instructional materials were fully underwritten from the Computing Center's operating budget.

The College administration supported the computing literacy programs through grants to faculty and administrators. These grants provided support by subsidizing individuals interested in acquiring personal computers and for professional development grants to pursue additional studies in educational applications and/or research.

Content and Structure of a Literacy Program for Administrators

In 1982, the Computing Center developed a program for educational administrators on how computers could be used as a problem-solving tool in an educational institution. The seminars focused on introductory computer concepts and problem solving through the use of applications systems rather than computer programming. Case studies were used to illustrate the application of these systems to educational institutions. No previous experience in computing was assumed.

The seminar format combined both lecture and "hands-on" learning activities in an attempt to provide the participants with actual experiences in using the application systems. To support this format, the program was conducted in the Computing Center Training Facility. The Training Facility was equipped with user workstations and a large-screen projection system. The latter allowed the teacher to demonstrate the concepts being taught.

Registration was limited so that there was no more than a 2-1 ratio of registrants to equipment. Wherever possible, there was a 1-1 ratio of registrants to equipment.

Applications systems for mainframe and microcomputers were taught in the seminar series. Registrants were given "hands-on" experiences using mainframe terminals and IBM Personal Computers. The choice of equipment was influenced by the applications system being taught.

The computing literacy curriculum consisted of a series of units. The syllabus and time allocations by unit follows:

- Computing applications in educational institutions (2 hours)
- Introduction to computing concepts (2 hours)
- Using applications systems for problem solving (3 hours)
- Word processing for report writing (4 hours)
- Electronic worksheets for modeling, planning and decision making (8 hours)
- Building information systems with a database system (3 hours)
- Analysis of data and presentation of summary statistics (3 hours)
- Presentation of data in graphics format (1 hour)
- An overview to integrated information processing (1 hour)

Some of the application systems used in the program were:

- MUSIC (McGill University System for Interactive Computing)
- MUSIC/MEMO (electronic mail)
- MUSIC/SCRIPT (word processing)
- VisiCalc (electronic spreadsheets)
- dBASE II (database systems)
- SPSS (data analysis)
- IBM GDDM and ICU (business graphics)
- LOTUS 1-2-3 (integrated information processing)

The administrators' literacy program was offered twice during the 1982-83 academic year. Two different formats were used to determine the one best suited to the administrator's schedules. The first time the program was presented as a four-day program. In the second offering, the material was divided into independent modules, presented in blocks of 2-3 hours, over the course of a semester.

Evaluation of Literacy Program

The year's experiences were helpful in determining the effectiveness of the program. Some of the areas reviewed were:

- Factors influencing administrator participation in the program
- Background of the administrator
- Contents of the program
- Structure of the program
- Resources (hardware, software, personnel, facilities) required to support the program
- Behavioral changes in the participants

Factors Influencing Participation in the Program:

A questionnaire was sent to the administrators participating in the program to learn which factors influenced their participation in the seminars. The survey indicated the following reasons:

- Lack of technical knowledge (87%)
- Curiosity about computers (53%)
- No cost for seminars (53%)
- Need to know the information (40%)

Background of the Participants:

The authors have proposed the following as a profile of an educational administrator seeking computing literacy:

- Highly motivated
- "Computer-phobic" to varying degrees
- Concerned about failure to master computing
- Under pressure from presence of colleagues
- Disadvantaged because of weak keyboarding/typing skills
- Unprepared for the amount of time required to become a proficient user
- Limited in time availability

Contents of the Program:

The modules on the use of application systems were the most popular with the registrants. Beginning users were not interested in the more abstract topics. There was usually considerable interest in expanding the introductory discussions of some application systems into fuller modules.

Structure of the Program:

The program evaluation indicated that the users preferred the series of independent modules to the intensive all-day format. It was better suited to their calendars and time commitments. The distribution of the material over the semester also allowed more time for the mastery of the material.

The faculty teaching the seminars have reported that there is a need to adjust the time allocated to the various topics. Some topics do not generate sufficient interest; it is recommended that some of these topics be removed from the syllabus. There are some topics which generate a great deal of interest and it has been recommended that these topics be expanded.

The faculty has also recommended that the format of the program be modified to agree with the learning styles and rates of learning by the participants. The combination of lecture and hands-on exercises was effective in starting the learning process, but not sufficient in itself to sustain and complete it. After a period of time, much of the knowledge was lost unless it had been applied. Users trying to apply the systems after a period of inactivity needed technical support to regain a level of useful productivity.

Hardware and Software Used in the Program

The time required to achieve self-sufficiency in using an application system seemed to be affected by the hardware on which the system was used. Beginning users found using the micrcomputers to be more complex than using terminals by a factor of 2-1 or 3-1. As a result, terminal users were self-sufficient more quickly than microcomputer users.

The users also responded more favorably to systems which were interactive, user-friendly, and non-technical in its interaction with the users. They learned more rapidly when an on-line help facility was available.

Computing Literacy and Behavioral Change:

Six months after the program was offered, the participants received a questionnaire which attempted to measure behavioral change in the participants. It surveyed them regarding the seminars they had attended, the systems they were currently using, and future seminars they would be interested in attending. The results of the survey indicated that:

- A small percentage of registrants were using the systems they had studied. Usage statistics were higher for the introductory applications:
  - Word processing (50%)
  - Electronic mail (33%)
- There was interest in attending additional seminars.
  - Introduction to microcomputer applications (26%)
  - VisiCalc (26%)
  - Word processing (20%)
  - SPSS and data analysis (14%)

A Proposed Strategy for Promoting Computing Literacy

To support future computing literacy activities, the Computing Center is:

- Refining the definition of computing literacy and the levels
- Redesigning the structure and format of a literacy program
- Developing techniques for the reinforcement of learning and literacy activities
- Instituting a different policy for funding a computing literacy program

Refining the Definition of Computing Literacy:

It is important to distinguish between computing awareness and computing literacy. Computing awareness encompasses the lower levels of the skills hierarchy (Levels 1-3). It focuses on awareness of the roles that computing plays in the individual's daily life and in society. Computing literacy refers to that skill level at which the individual has some mastery of the hardware and software and is a regular user of computing. Using this distinction in the current environment, computing literacy would not be reached before Level 5. However, the dynamic nature of computing technology makes continued evaluation and refinement of any definition of either computer awareness or computer literacy an on-going activity in a computer literacy program.

Structure and Format of the Program:

The authors are in the process of revising the syllabus for the seminars. Some of the more abstract topics will be moved to the end of the syllabus or removed from the program. The time allotted for certain systems is being expanded. More laboratory sessions are being scheduled. The overall effect is to increase the length of the program. It must be determined if the administrators' schedules can accommodate a longer educational program.

Because of the experiences in the program, the authors are proposing that a format similar to the NSF Chattauqua seminars be adopted. Under this structure, the seminars would be split into two portions. The interval between segments would be long enough to permit the registrants to complete an application of interest to them. Reports on user projects would become part of the seminar.

The authors are also considering offering the seminars off-campus. Removing the participants from the interruptions of daily campus activities might reduce the number of individuals who do not complete the program because of interrupted education.

Funding a Computing Literacy Program

The authors feel that the current "no charge" policy is not cost effective. They have recommended that a fee structure be associated with the seminars. The fee could be covered by an administrative mechanism such as a departmental charge-back system. In addition, professional development grants could be used to cover the cost of the internal education.

Summary

The experiences have shown that administrators are interested in a computing literacy program. This project has provided the authors with greater insights into designing a curriculum and a delivery mechanism for a computer literacy program for this audience.

There has been a marked attitudinal change among the administrators. They are more receptive to the integration of computing into their daily professional activities. However, it would appear that the majority of the users are still in the early stages of computer literacy and are not ready to make computing part of their basic mode of operating.

The validity of computing literacy as an institutional goal appears to have been accepted. The next step is the development of effective delivery mechanisms to allow this to take place. The length of time needed to bring about behavioral change and for individuals to progress between stages of literacy appears to be much longer than originally anticipated. It may be necessary to review and adjust proposed timetables for establishing computing literacy across an academic community.

Computing literate campuses will not become a reality until all the groups within the academic community have access to computer literacy programs with a curriculum and a delivery mechanism that meets the needs of their user groups. The development of a computing literacy program for educational administrators is an important step in achieving this goal.

TRACK VI
Approaches To Office Technology

Coordinator:
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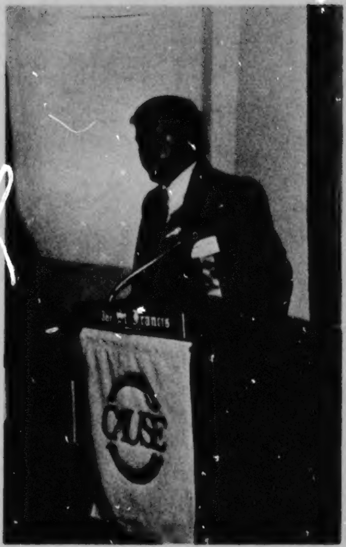

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Assessing the Need for and Initiating Office Automation in the University Setting
(Based upon a Report of the
Information Processing Task Force
of Northern Kentucky University)

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Contained within this document is a summary of the review process conducted by the Information Processing Task Force and the subsequent recommendations which flowed from an analysis of collected data. The recommendations result not only from analysis of the data, but are based upon a thorough review of current literature, information collected from vendors, and an assessment of related activities at other colleges and universities.

Assessing the Need for and Initiating Office Automation in the University Setting

Introduction

The purpose of this presentation is to relate the successful experience of Northern Kentucky University in assessing the need for and initiating office automation on its main campus.

Northern Kentucky University is a public institution of higher learning with an enrollment of 10,000 students in sixty-five undergraduate programs, two graduate programs, and one first-professional program. Founded in 1968, the newly built main campus in Highland Heights, Kentucky, in the Greater Cincinnati Metropolitan Area has nine buildings which cost approximately $75 million to construct over the past ten years. With an annual operating budget of $30 million, Northern employs approximately 300 faculty and 450 support staff in seeking to accomplish its instructional, research and public service missions.

During the 1982 academic year, a "Management Review Study of Kentucky's Public Colleges and Universities," was submitted to the Kentucky Council on Higher Education which recommended several strategies to enhance the management of Kentucky's institutions of higher learning. Specifically, the study made the following recommendation for Northern Kentucky University concerning information/word processing.

> We recommend that Northern first conduct a thorough review of its need for word processing equipment throughout the campus and, secondly, identify and evaluate the costs and benefits of alternative word processing systems capable of fulfilling those needs.[1]

A campus-wide Information Processing Task Force (IPTF) was formed at Northern Kentucky University to identify and assess information/word processing needs, compare and evaluate equipment configurations, and recommend the operational concepts of installation. The Task Force completed a well-documented process of assessment which included activity logs for both secretarial/clerical personnel and managerial/administrative personnel as well as questionnaires and interview documents for both of these important user groups. The logs served as actual two-week work measurement documents while the questionnaires were designed to obtain information about working patterns, habits and cycles. The interview document facilitated personalized in-depth feedback and provided a one-to-one information exchange opportunity. This thorough procedure yielded considerable data concerning the office activities carried on within the University setting.

Regarding equipment evaluation, emphasis was placed on mainframe compatibility and upon multifunctionality. In the University setting, equipment potential seemed to be a key factor; not just growth potential but potential for creativity and flexibility within the architecture of the system. The expressed needs and applications were both numerous and diverse; moreover, these expressed needs seemed to be changing and developing. Systems analysis was based in a philosophy that user needs were controlling factors and the system should fit the need. Individual users were encouraged to exchange routine tasks for the creative challenge of automation.

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[1] Management Review of Kentucky Colleges and Universities, Phase II, prepared by Price Waterhouse and MGT of America for the Kentucky Council on Higher Education, July 8, 1982, p. VI-46.

The initial introduction of office automation in the University setting suggests a pilot program or phase-in scheme. The IPTF recommended that initial installations satisfy three environments: (1) the pure word processing situation which consists primarily of text editing, (2) the information processing situation which requires forecasting and modeling capability, and (3) the data processing situation which involves the creation and storage of records which are vital to a specific area yet cannot be accommodated on the institution's mainframe.

The IPTF attempted to address current University needs, looked at developments in hardware and software which were predicted by vendors and trade journals and considered the future of the University and how its growth and effectiveness might be enhanced by office automation. In addressing the charge to the Task Force, the IPTF looked beyond the acquisition of equipment and considered a possible structure for an organizational unit of word processing, the personnel needed to staff and perform the work of such an area, the physical constraints of configurations which require a hardwired installation, and the policies which affect the determination of word processing as it relates to the mainframe computer which houses administrative data of the University.

The resulting recommendations are in some respects ambitious and, at another glance, very conservative. It was the goal of the IPTF to establish the most advantageous method of entering into the world of office automation. The recommendations suggest the consolidation of services and the initiation of a new manner of satisfying the information needs of the University by crossing organizational lines to share equipment and communication channels. A conservative step into the information processing market is anticipated by limiting initial acquisitions to shared resource or shared logic service facilities with growth potential.

Data Collection and Analysis

The IPTF conducted a two-week data collection period. Prior to the measurement period, information concerning the upcoming process was shared with all units on campus. At the conclusion of the measurement period, IPTF members conducted interviews to gain additional input from the offices on campus.

The IPTF consulted vendors and studied the sample documents available in educational publications and trade journals as part of the process of constructing the survey instruments. Six documents were prepared:

(1) A support staff log which served as a record of activities occurring during the two-week measurement period;

(2) An originator's log which served as a record of activities occurring during the two week measurement period;

(3) A support staff questionnaire which summarized the activities of the units. The questionnaire was completed by the designated lead support staff and addressed peak work-load schedules, crucial tasks, and time frames;

(4) An originator's questionnaire which summarized the activities of the unit and addressed work flow, importance of documents, manner of preparation, and concerns for work flow improvement;

(5) An inverview document which sought information and feedback which may not have been addressed in the measurement process; and

(6) A departmental profile which summarized all of the information collected from the departments. Areas analyzed in the profile included volume of work connected with text preparation, mainframe communications, filing and indexing needs, and CP/M software requirements.

Analysis of the data reflected that much time is wasted in retyping text. As documents go through the revision cycle, secretaries retype entire pages to add or delete text, or in some instances, edit a few words. Because of this complete retype, the document must be reproofed by the secretary and the originator. In those departments not equipped with automated typewriters, repetitive work demands original keyboarding of each item to produce the "original" document required. It was also noted that for many courses banks of test questions which are used frequently could be stored, randomly recalled, and printed. This procedure would free secretaries from the time consuming task of constantly typing and retyping tests. Additionally, vitae and syllabi could be stored, updated as necessary, and recalled for use when applicable. Manuscript preparation and retention could be a service provided through automated office procedures as an aid to scholarly endeavors of the faculty and administration. Administrative office expressed a concern with the cumbersome process required to collect and summarize (list) information and the time consumed in the preparation of handbooks and manuals which are in constant need of update and revision.

The IPTF has made an effort to objectively weigh and consider the information gained from the two-week period and the subsequent interviews. Each member of the IPTF has reviewed all of the interview documents as well as a departmental provile which summarized the data drawn from the numerous forms. However, as is true of any such collection process, there was considerable flexibility in the interpretive process. Nevertheless, a review of the collected data did permit ample opportunity to assess high, medium, and low volume work loads and to identify subsequently the basic needs and potential uses for automated equipment.

Configurations and Market Analysis

The IPTF was charged with identifying and evaluating the costs of word processing systems which might serve the needs of Northern Kentucky University. In fulfilling this charge, a number of configurations were studied:

Central Processor--Currently, limited word processing functions are being performed on the University's academic mainframe. It has been recommended to the IPTF that the University invest in additional terminals and provide all academic departments with access to this mainframe processor. Terminals and modems cost approximately $2,000 each. Hardwired devices are better suited to word processing because of substantially increased transmission speeds. The letter-quality printer that served the mainframe is currently housed within Computer Services; but with the addition of a greater number of remote users, it would be necessary to install remote printers. Printers cost approximately $2,400 each. Mainframe word processing is adequate for those who desire remote dial-up access and who are not constrained by the limitations of available software. The primary advantage of word processing from a central processor is telecommunications access. However, mainframe word processing is less user friendly, has some limited functions, is command intensive, and is not state-of-the-art in word processing.

Multi-functional Stand-alones--Primarily, this configuration consists of personal computers which perform word processing functions via CP/M software. Again, as the name implies, personal computers are computer oriented and command intensive. The IPTF viewed demonstrations of personal computers available through various vendors and concluded that a word processor with CP/M capability offered a much broader functionality and was considerably more friendly. The strength of the personal computer is the ability to manipulate data; unfortunately, in the absence of mainframe communications the user creates his/her own data base which would result in great duplication of effort in the University setting. Information gathered from current periodicals indicates that connecting personal computers to a mainframe in order to share data or download can be expensive in terms of the amount invested in the personal computer. Most personal computers are in the $7,000 range; this figure includes the cost of a dot-matrix printer. Several of these devised interfacing with the mainframe could create a high volume of activity which might be consolidated through the use of other available configurations.

Shared Logic--Many vendors market shared systems which accommodate as few as four peripherals and as many as thirty-two peripherals. The shared logic configuration may function as a mini-computer with word processing capability or as a word processing system with CP/M software capability and mainframe communications. The disadvantage to shared logic is the expense of the main CPU. Costs range from $6,000 for 4.2 megabytes (500 pages) of hard disk storage to $52,000 for 275 megabytes (100,000 pages) of hard disk storage. Additionally, a shared logic system requires extensive hardwire since each peripheral must be hardwired back to the CPU. Peripherals should be within 2,000 feet of the CPU.

The major advantage of installing shared logic systems includes potential for growth through upgradeability as well as through the addition of peripherals. The average cost of a terminal is approximately $4,500 to $6,500 depending upon terminal memory and other features available; letter-quality printers costs approximately $2,700 to $6,000 based on the print speed. The systems demonstrated for the IPTF can simulate a number of configurations. The terminal loaded with CP/M software and served by a printer located in the same office area serves as a multi-functional workstation (personal computer). In areas where confidentiality is imperative, a terminal and printer can be positioned to simulate a stand-alone unit. With the installation of archiving terminals, users have the capability of storing information on diskettes instead of utilizing the hard disk storage. While potential growth is the major attraction to shared logic systems, other advantages include the ability to share data between workstations, communication between workstations, and communication between the CPU and the University's mainframe.

Shared Resource--This is perhaps one of the best known and most utilized configurations. A limited number of terminals are hardwired to one printer and for an investment of approximately $30,000 can serve one office, one department, or through a central concept several departments. By utilizing shared resource facilities, the potential for growth is limited. A shared resource system is limited in functionality and serves primarily as a word processor. However, it also represents a lower financial investment. Also, shared resource devices may communicate with the University mainframe through terminal emulation for the purpose of accessing data files.

Stand-alone--This configuration consists of a terminal and a printer and is usually found in the traditional office setting and typically serves just one office. The stand-alone, an investment of approximately $15,000, is basically the same equipment as found in the shared resource system and may have the growth potential for adding terminals to the original terminal and printer. The stand-alone may have communication capability but is usually found in a setting where information is stored on diskettes and is not shared with other systems or with a mainframe.

Operational Concepts--In addition to considering the configurations available, the IPTF has also considered the operational concepts available in information processing. In many instances, the configuration dictates the operational concept. Personal computers are most suited for the professional workstation. Their weakest function is as a word processor and their strength is found in data manipulation and other activities suited for the concerns of managers and executives.

The individual work station and the stand-alone configurations are compatible and resemble the typical traditional office environment.

The concepts most carefully scrutinized by the IPTF were centralized and decentralized operations. Decentralized word processing is performed through shared-resource systems which serve limited areas, through shared-logic systems which are configured as stand-alone units, or through stand-alone units. The concept of decentralized word processing is tied more to the area of service than to the equipment configuration. In a decentralized environment, the area served by the operation is limited to a small group of users, one department, or one office. The centralized concept functions to serve an expanded area, several departments, a building, or an organizational unit. Centralized word processing can be performed on a mainframe, a shared-logic system, or initially through a shared-resource system.

Under decentralized arrangements, existing University personnel would operate the equipment which is placed in the normal office setting. In a centralized arrangement, the equipment would be operated by full-time operators. In a centralized arrangement, the output from equipment, or in other words the return on the investment, is increased significantly because of the constant day-long usage of the equipment, the increased familiarity with the functions, and the concentrated development of skills. The investment in a centralized concept extends beyond equipment costs and includes personnel costs.

In actuality, the operational concept is in many instances transparent to the user and does not affect the capability or functionality of the terminal. In assessing operational concepts, the IPTF placed significance on the growth potential provided by the various concepts. The decentralized arrangement permits growth through independent acquisitions and does not readily lend itself to mass storage and the sharing of information among multiple users.

Centralized concepts permit a more planned approach to growth. As the demand increased and users demonstrate the need to expand beyond the central operator arrangement, the shared logic system readily permits the addition of terminals and printers in user departments. Many shared logic central processors are equipped with internal operating systems which record and compile information about the amount of time logged on the system and the number of pages of text each user generates. It is a concern of the IPTF that the growth of information processing be a well thought out and planned growth. The means of meeting multiple needs through a single device as well as minimizing the number of users directly interfacing with the University mainframe appear to be worthy goals for information processing as a service area.

Data Downloading

Beyond technical considerations regarding hardware communications between the mainframe computer and various remote devises, which are addressed elsewhere in this report, is the need to obtain actual data from the mainframe. First, it is recognized that numerous selection criteria will need to be applied to a choice of scores of data elements. This is further compounded by the multiple files which might be accessed, ranging from student records and personnel to financial data and combinations from files. Thus, it will be necessary for the University's Computer Services to develop individual computer programs which are designed to abstract data which will meet the needs of the various organizational units or users. Decisions to provide data downloading should be made on a project basis and in accordance with application development priorities as determined by the University's Computer Services Policy Committee. However, it should be emphasized that to avoid data redundancy, duplication of effort, and to maintain data integrity, data must come from a central location.

Hardware Communications

The need on campus for remote hardware communications becomes perplexing when consideration is given to location of files, type of mainframe computer, type of remote device, type of application, data transmission speed, distance between points, physical barriers, and ambiguities about some of these issues when specifics can reduce uncertainty. It would appear that the accommodation of hardware communication should not be addressed for word processing without consideration for instructional information, management information, operational information and other needs.

However, the IPTF has used hardware compatibility with the University's administrative mainframe as a criterion for its recommendations. Moreover, this should be a key consideration in the equipment acquisition process. Implied in the previous discussion of how the issue of communication is perplexing are examples of specifics which should be known before campus-wide communications, or for that matter a single setup, should be designed. For example, it is known that telephone dial-up access can provide a transmission speed which could make this method of access impractical for some applications. Summarily, while there is a risk of being too simplistic, with what indeed is a technical issue, a precise description of how communications might be accommodated is presented as a subsequent recommendation.

Summary and Recommendations

As a summary to the information presented thus far and as a preface to the recommendations which follow, it is appropriate to look closely at the environment in which this report has been formulated. While the IPTF was involved in their activities, the Computer Services Policy Committee, working with an external consulting agency, formulated the following strategy:

> The central processor used to support administrative information processing will not be used as a word processing facility. However, a limited number of administrative offices may justify a need to "down load" data from information files to support word processing activities on a decentralized basis. Thus, communications may be required, in conjunction with administrative information systems, but the host system will not support word processing.
>
> Administrative word processing needs may be fulfilled by a variety of hardware configurations such as: electronic/memory typewriters, stand-alone text processors, shared resource systems, shared logic systems, multi-functional stand-alones or microprocessors, and terminal access to a remote central processor.[2]

Northern Kentucky University had begun to address word processing through some of the hardware configurations listed above before the IPTF began its work. Some faculty projects were already being accomplished via the academic mainframe, several offices have access to electronic typewriters with disk storage and there are several micro-processors using word processing software.

In keeping with the above strategy, the IPTF has determined a method of entering into office automation and bringing together the need for text preparation and information processing. The recommendations and discussions with vendors have centered around the potential for office automation and the enhanced productivity of Northern's staff.

A considerable volume of information on user needs and appropriate equipment acquisitions is available in today's market. The concern of the IPTF is that the operation of the institution not become equipment driven. For this reason, the bases of the recommendations center around the introduction of information processing capabilities beyond those in current existence. Through a Project Director, it is believed that personnel at Northern may become acquainted with the benefits of office automation and the functions available through this advanced equipment. Offices will then be in a position to determine how the equipment will enhance their work rather than arranging to conform to the system.

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[2] "Systems Strategies," Computer Utilization Project, Northern Kentucky University, Fall 1982.

The IPTF takes the position that word processing as an organizational unit will provide a service for University departments while placing these offices in a better position of assessing the impact that office automation has on the traditional office. The long-range plans for information processing may limit the number of vendors supplying equipment to the University and may look to a communications network. Such plans will be formulated as the University utilizes the equipment acquired as a result of this project. Of concern in the formulation of long-range plans is the objective that data remain secure and reliable and that a variety of configurations and operational concepts be available to information processing users.

The IPTF's efforts serve as a foundation for an area of growth which will significantly affect the creation and exchange of information on the campus and open the way for increased University service to other various constituencies.

Many needs will remain unmet following implementation of the recommendations, particularly in the administrative offices. Various constraints, including funding, force the IPTF to prioritize needs and compromise ambitious plans. It has been the goal of the IPTF to satisfy some of the critical needs expressed in the student service and academic support areas. If additional funding becomes available, additional recommendations for users who currently are able to justify equipment acquisition would be made.

Recommendation I--That an Administrative Support System be established in the University's Administrative Center. This system would consist of a shared logic configuration utilizing a decentralized operational concept. Equipment purchased should contain approximately eight megabytes of hard disk storage and have sufficient ports to satisfy the original peripherals and permit additional users to access the CPU as needs are identified and funding becomes available. The initial users are: student services, alumni affairs, accounting, and university relations. Initially, nine peripherals will serve the Administrative Center.

Recommendation II--That an Administrative/Academic Support System be established in the Chase College of Law. This system would consist of a shared resource configuration utilizing a decentralized operational concept. The shared resource configuration utilizes diskette storage and consists of three terminals and one letter-quality printer. The printer and one terminal are to be located in the administrative area. The remaining two terminals are to be located in academic offices. This configuration is not expandable but will begin to address the various needs of the College of Law which include correspondence with students, test and syllabi preparation, manuscript preparation, as well as provision of some limited administrative support.

Recommendation III--That two Academic Support Facilities be established, one in the Landrum Center and one in the BEP Center. The facilities would be operated by specifically trained word processing operators. The facility located in Landrum would serve the needs of the academic departments in Natural Sciences, Fine Arts, Landrum and the Library. Should additional funding be available, an Academic Support Facility in each of these buildings would be desirable. The facility located in BEP would serve the needs of the academic departments in BEP and the administrative departments in the University Center and the Administrative Center. Both facilities would consist of shared logic configurations and centralized operational concepts. The facilities would provide a service to the user departments which would include manuscript preparation, test and syllabi preparation, special project assistance, handbook and manual preparation, and mass mailing assistance. Each facility would require an initial eight megabytes of hard disk storage and one of the two terminals in each center would need archiving capability for the added protection of confidential information.

Recommendation IV--That a satellite work station to the shared logic configuration in the BEP Center be placed in the offices of the Dean of the College of Arts and Sciences and the Dean of the College of Professional Studies. The needs expressed in this area include text processing, information processing, and mainframe communications. This satellite would consist of two terminals and one letter-quality printer. When Community Research and Services moves to the BEP Center, they should also become a part of the satellite concept and add an additional terminal and printer.

Recommendation V--That a Project Director be named to facilitate and enhance the purchase, installation, and utilization of information processing equipment. Both vendors and users have shared with members of the IPTF their concerns that equipment in the market today is capable of performing far beyond the general level of utilization. Operators normally receive training on the full capabilities of the equipment in the first few weeks following installation. The equipment then enters a period of utilization where many features fall into disuse and both vendors and users seem to fear that the numerous shortcuts available to the operators are forgotten.

The IPTF believes that a Project Director would provide direction and support to operators, would share in the decision making process in prioritizing work, would solicit work from departments reluctant to enter into a centralized environment, would analyze cost/performance factors and would monitor the rate of equipment usage and equipment acquisition as well as monitor the trends in office automation. At this point, the IPTF could assume the postion of advisory panel to the Project Director in developing policies, procedures, short- and long-range goals for the area of word processing at Northern Kentucky University.

Recommendation VI--That the University employ four operators, two for each facility in BEP and Landrum. Additionally, it would be beneficial to employ four work-study students to work in the afternoons and evenings. With consideration for the expense of the equipment and the extensive keyboarding to be accomplished during the first year, student workers would provide an invaluable service.

Recommendation VII--That the University retain a communications specialist for the purpose of "determining a feasible communications network for accommodating the diverse remote access needs on campus." The IPTF recognizes the difficulty of addressing word processing and its related needs for remote communications without consideration for instructional, operational, management information, and other needs. In order to develop a long-range plan for communication between the mainframe, word processing devices, and other terminals, it will be necessary for the IP Project Director and the Director of Computer Services to work closely with this specialist in the coming year.

Recommendation VII--That the University establish a preferred vendor list based on the following criteria: (1) market strength and growth potential, (2) equipment configuration recommendations, (3) equipment software capabilities, (4) communications capabilities, (5) maintenance/service support, (6) references-evidence of higher education familiarity, (7) special features, (8) educational/training opportunities, (9) functionality.

"OFFICE AUTOMATION" - MANAGING CHANGE

by

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In the broadest sense, "Office Automation" is the rubric under which large DP organizations will march towards distributed processing. It is important to recognize the phases in this process that the industry is trying to impose on DP users. It is important to be sure, through the understanding of functions, integration, and system architecture that the capitalization required in the move to distributed processing is spent wisely. How to achieve corporate standards in office automation/decision support in the unique management structure of Higher Education will also be discussed.

Throughout the development of the concepts presented in this paper the following basic tenets were applied. Though there is certainly room for discussion and even argument on each of these points, there seems to be increasingly weighty evidence to support the logical correctness of the organizational style implied by these tenets and the policies which eminate from such organizations.

BASIC TENETS

1. Distributed processing is here to stay - Centralists (in the functional, data processing sense) won't survive.
2. Distributed processing implies decentralization of function, machines and possibly DP organization.
3. Centralized control of decentralization (distributed processing) is an imperative.
4. Modern, decentralized data processing and telecommunications must be organizationally one and the same.
5. The "user" has a right to expect and even demand "one-stop shopping" for data processing, office automation/decision support and telecommunications (to include both data and voice).

Data processing has evolved through many stages in the relatively short time of 25 to 30 years. Many DP organizations are struggling to escape from the "Age of the Dinosaurs" and to emerge into the "Modern Era" of data processing. This transitional struggle to move from a large, central, corporate data base mentality into an era of office automation, decision support, distributed and personal computing functions is marked by the following characteristics:

1. Guerilla Warfare - User groups (are formed to work against "big D.P.".) Networks of office machines spring up.
2. User Revolt - Data processing has taken the users data and locked it away in inaccessible, centralized data bases and they are mad as hell and won't take it any more.
3. The Promise of Technology - The users are not ignorant of the potential of the personal computer and its functions. They are demanding more control over data and its processing and use.

In order to be successful in this effort at modernization it is essential that there is an adherence to several key strategies.

1. Separate the Ends From the Means - Don't glorify the hardware or even the software. What is being developed is a compatible architecture and set of functions that will grow into the future. Software and hardware change rapidly - the things coming out tomorrow will be better and cheaper than what we have today. An organization must be able to fully accommodate this industry flux within a data processing architecture.

2. Automate the Principals - Develop tools to support the "Knowledge Workers" in the enterprise.
3. Capitalize the Professionals - Too much money has been spent in the "office" on secretrial functions. Increasing the efficiency of information handling is desirable but improving the effectiveness of information use is far more important. It is criminal to continue spending $15,000 - $20,000 for a word processing workstation at this point in time.
4. Provide a Framework for Productivity - Two memos are not better than one. It is better to provide tools to help the professional do his job more effectively, and secondarily to communicate more efficiently.
5. Better Business Decisions - are the best notion of productivity increase; this is the primary emphasis to involvement with office automation/decision support activities.
6. Develop a Marketing Strategy - Ideas must be sold to higher management and, in an educational institution, must also be "sold" to potential users if a proliferation of non or semicompatible collections of PC's and Word Processors is to be avoided.
7. Be in Step with The Industry - Recognize where distributed processing has been and where it is going. Don't be too much of a pioneer; but conversely, don't commit to dead-end or obsolete equipment.

It is important to reflect on the types of equipment that the industry has brought to the marketplace in the past. It is also essential to accurately predict what will be offered in the future. With some liberties and generalizations the following list suggests such a continuum:

1. Stand-alone Word Processors. The first of these were electronic typewriters of the MTST type, later models were the Lanier's, Wangwriters, Xerox 860's etc.
2. Shared Logic Word Processors. These machines allowed documents to be electronically passed from one terminal to another usually on a subdepartmental basis. Examples of these were WANG OIS's, IBM 5520's and the like.
3. Departmental Networks - possibly growing out of a network of word processing stations such as ethernet connections of Xerox workstations, large WANG OIS or early VS networks.
4. Personal Computers - These were originally bought by the more technically oriented members of an organization. Rates of expenditure for P.C.'s probably have surpassed those for pure word processing machines at the current time within a given institution.
5. Full Function P.C.'s/Word Processors. Word processing software of increasing quality is generally available for every P.C. while many word processors are now running P.C. style software and operating systems.

6. Integrated Functions. Such systems as the Apple LISA, Lotus 1,2,3, and the DEC All-in-One feature spread sheets that plug directly into graphics packages and to report generators. The resulting documents ideally could be included as part of a text document as well. Integration among functions is one of the key concepts to demand from an office automation/decision support architecture.
7. Complete, Alterable Document Exchange. Systems have been emerging which allow a Document Content Architecture to exist throughout a distributed processing network. The ability to create, file, retrieve and send an alterable document to any compatible terminal in the network is a second important concept in architecture selection for distributed processing. It is also essential that data, text, graphics, reports, image, and voice be likewise combined and integrated throughout the network on a document content basis.
8. Corporate Data Access. Though a very few years ago P.C.'s were purchased with the intent of manipulation of small, private databases, tomorrow's executive or analyst will want to manipulate corporate data in a relational data base concept. Ability to "down load" and "up load" data from the office system network to the corporate mainframe is a third essential requirement for making a proper architecture selection for an office automation system.
9. The Replacement of Classical Data Processing. Once it becomes apparent to application systems developers that a document compatible device exists in virtually every organization within an institution, then some very exciting possibilities will exist for systems development. This latter day development will be characterized by forms-driven, on-the-fly application development where prototype systems can be put up rapidly for further refinement.

It is hard to say with great accuracy where the industry is at the current time. It would appear that step 6.5 (referring to the list above) is about where the industry is today. It would therefore, be important not to commit large amounts of equipment acquisition dollars to, say, shared logic word processors at this point in time. It would also be important to select an architecture that will likely carry forward into the latter stages of completely distributed architectures.

Thus the term "office automation" has been expanded from its ostensible meaning to include business communications, word processing and decision support. In a recent task force on office automation/decision support at our large, multicampus university the following weights were given to the various functions in an evaluation/selection process.

Business Communications	35%
Word Processing	15%
Decision Support	50%

The functions that were to be separately evaluated are given below:

Business Communications

1. Electronic Mail
2. Electronic Filing/Retrieval
3. Host-Based Archiving
4. Scheduling/Calendaring

Word Processing

1. Compatible With Mail
2. Industry Standard
3. Memo Editor
4. Envelope or Paperclip Concept

Decision Support/Personal Computing

1. Spread Sheet
2. Relational Data Base
3. Presentation Graphics
4. BASIC, PASCAL, etc.

Since one of the essential strategies involved in the effort was not to be enamored of particular software, several tactical variables were also weighted in a companion evaluation to the rating of functions; these were:

Tactics		
1.	Cost	20%
2.	Degree of Integration	30%
3.	"User Friendliness"	30%
4.	Accommodation of Existing Hardware	20%

With both functional and tactical rating schemes as well as demands for integration, document exchange and corporate data access well in hand the University of Illinois' Task Force debated the merits of various generic architectures (see Figure's 1 and 2). The vendors that were carefully investigated vis-à-vis the evaluation criteria were:

Vendors

1. IBM - PROFS, Displaywriter, ADRS
2. PRIME (Lincoln National Life)
3. AMDAHL - UNIX, UTS
4. APPLE - LISA, NESTAR
5. DEC - All-in-One
6. WANG - VS Office

FIGURE 1 - DEFINITIONS

FUNCTIONS
1. Business Communications - COMMO
2. Word Processing - W.P.
3. Decision Support/Personal Computing - P.C.

WORK STATION TYPES
1. Dumb Terminal - D.
2. Word Processor - W.P.
3. Personal Computer - P.C.
4. Full Function Terminal - F.

A brief discussion of each generic architecture ensues:

1. Host-based. This basic scheme had many inherent advantages. Only one copy of software need be maintained. Virtually any cursor - addressable "dumb" terminal could participate in full network functions (protocol conversion implied). The main disadvantage was that the notion of a personal appliance was lost in that users of the system would have to contend for resources - something that users were already reluctant to do.
2. User Based. This represents another attractive scheme in that all functions except business communications would be performed on the users own, personally controllable machine. Drawbacks are that the entry level cost was high from the users standpoint, and not everyone had a P.C.; some had various other terminals. Also, the user was limited in processing power to that of the P.C.
3. Mixed. The best of all worlds if carefully selected. All types of users would be accommodated: Those who had ASCII terminals or 3270's or those that wanted a predominantly word processor orientation to their work station, as well as those who were willing to make the investment in a compatible P.C. Ideally, all brands of word processing, whether they be based on a word processor, the host or a P.C., would be able to generate, file and exchange compatible documents. Likewise, the spread sheet commands learned for the P.C. would ideally be the same as the commands used by a 3270-like terminal running the same function on the host.

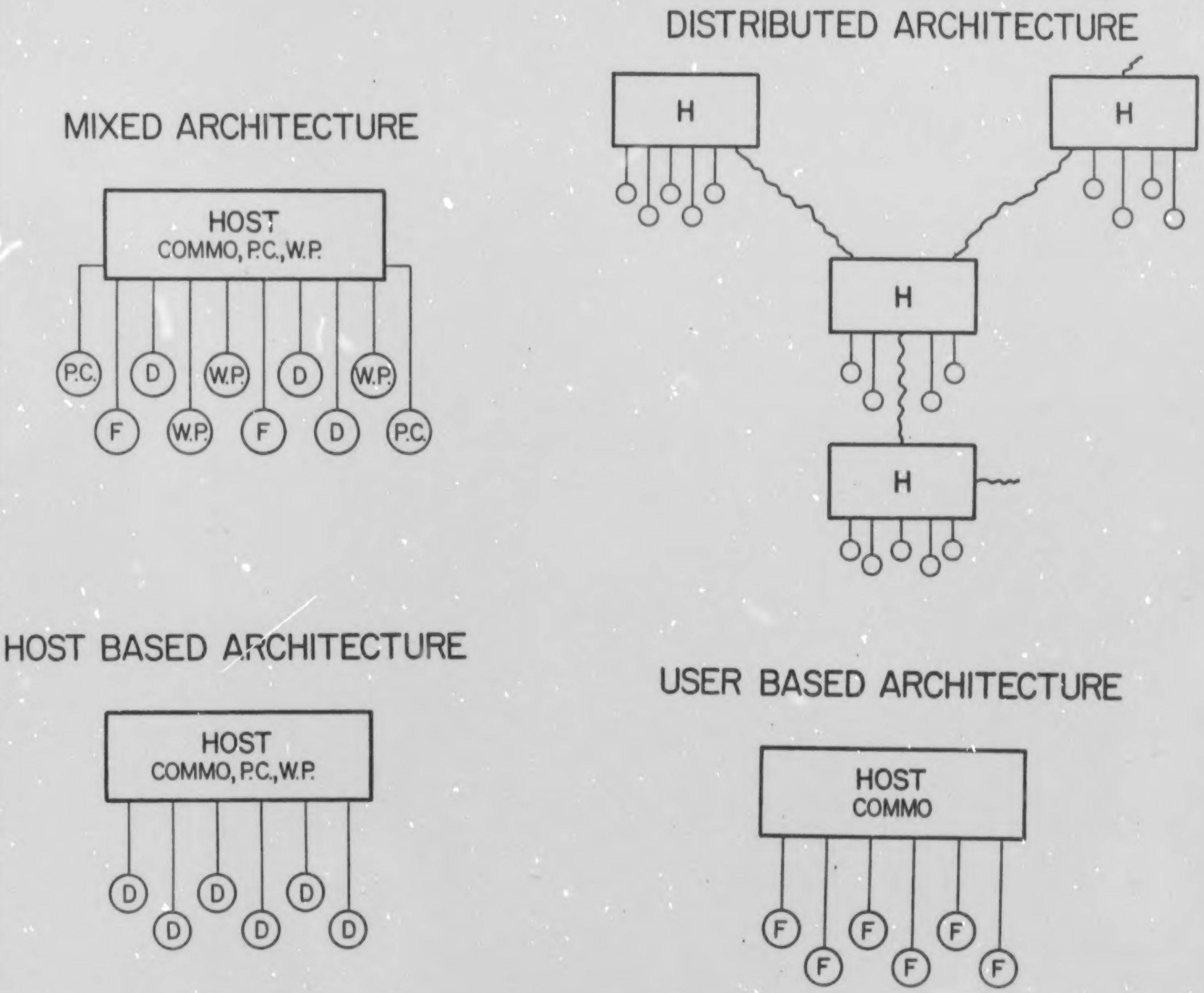
DISTRIBUTED ARCHITECTURE
H
H
H
H
MIXED ARCHITECTURE
HOST
COMMO, P.C., W.P.
P.C.
D
W.P.
D
W.P.
F
W.P.
F
D
P.C.
HOST BASED ARCHITECTURE
HOST
COMMO, P.C., W.P.
D
D
D
D
D
D
USER BASED ARCHITECTURE
HOST
COMMO
F
F
F
F
F
F

FIGURE 2 - ARCHITECTURES

4. Fully Distributed. This architecture is presented to illustrate that in a large business organization a network of host processors would eventually provide the "office automation functions". Thus it becomes clear that all functions and elements selected for the office automation/decision support environment must be network based products.

Briefly the six vendors shook out in the following ways according to our task force investigations:

1. AMDAHL-UNIX. Too complex for the administrative environment. Good mail system. Will be of great interest to the scientific/engineering community.
2. DEC-ALL-in-One. Excellent integration. Closed architecture requiring VT100 compatible terminals. Pro series software late. POS not an industry standard.
3. PRIME-INL - Graphics not ready yet from INL. Excellent low cost, well integrated approach. Support of 3270 and IBM P.C.'s still in developmental stages. Uses all dumb terminals (Host-based architecture).
4. WANG - VS office appears to be a high function, well-integrated product but 6-9 months away. Completely closed architecture requires scrapping 95% of existing hardware at the University of Illinois. Communications for full function work station usage requires direct attach or committment to WANGNET.
5. APPLE LISA. - Most user - friendly system to date. Well integrated except for LISA LIST. Word processing passible but needs to be improved. Large scale communications uncertain.
6. IBM - PROFS-DCF-ADRS - Provides a reasonable approach to the ideal mixed architecture. Displaywriter is compatible with DCF/SCRIPT for 3270 terminals. VM pass-through allows 3101 access to functions. ADRS runs on mainframe and P.C.'s. Well stated architecture.

A complete point to point evaluation was made by each member of the task force. Each system was rated as to specific function and tactical assessment. The results showed the following:

* DEC, WANG, and IBM all rated essentially the same overall score when functions were considered.
* In a tactical sense IBM was the overwhelming choice, primarily when cost and use of existing equipment were taken into account.
* Among the three highest rated systems, IBM was rated least user friendly and lowest in word processing.
* Strong points, for IBM were in Business Communications and in the spread sheet, graphics, data base area. Thus IBM was selected since an entire network of compatible terminals

was already in place with a community of several hundred potentially compatible IBM P.C.'s.

After the recommendation was made, the task force is now involved in rapidly bringing a marketing approach forward for top management approval. A marketing plan is absolutely essential at an institution of higher education where often decentralized decision making is the order of the day. A successful marketing plan will have the following elements:

1. Provide a Bundled Financing Package. - Where a user can purchase a 3101, IBM P.C., Displaywriter, 3270, etc. at a fixed monthly rate. Payments will be specified for each type of terminal vis-à-vis host software usage. Strong emphasis will be placed on subsidizing the mail/business communications system since the utility of a mail system is low until a large number of users have mail boxes.
2. Complete Planning Services. Careful user requirements analysis to steer users to the most effective terminal. Ordering of all equipment and communications facilities to include installation.
3. Training. This is the most important aspect of a successful effort in office automation. Classes, videos and rewritten users manuals will be developed.
4. Consulting. A hand-holding service for users will be provided through existing information centers to assist individuals with the myriad problems of getting started in such a system.
5. Supplies. A complete central source of paper, ribbon, diskettes, software upgrades, manuals and training materials will be provided.
6. Maintenance - A depot - level maintenance service will be part of the bundled cost of a terminal. If a terminal "breaks" it will be wheeled out and another put in its place in a matter of an hour or less.
7. Network Advantages. Policies will be sought within the equipment acquisition procedure to allow D.P. personnel to "jawbone" individuals who are purchasing word processors or P.C.'s as to how compatible their equipment will be with the administrative network architecture. The functional advantages of joining such a network on a compatible basis will be explained to potential equipment buyers.

In summary, a need to modernize the face of ADP at all businesses and institutions is recognized. In order to make sense out of extensive annual expenditures for largely unrelated equipment under the office automation/personal computing category, a compatible network strategy needs to be adopted and sold on a marketing basis.

OFFICE COMPUTERS: MANAGING THE HUMAN IMPACT

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ABSTRACT: Technology is overrunning the office. Each new report of the office automation market indicates the pace is quickening and suggests that in five more years the office worker without a terminal or desktop computer will be the exception. What are the psychological and ergonomic impacts of this technological flood? What are the ramifications in training, in personnel administration? This paper outlines issues in these areas, and suggests some ways for us to manage and "soften" the change to a computer-based office environment.

OFFICE COMPUTERS: MANAGING THE HUMAN IMPACT

Current Trends and Why They Might Be Frightening

Technology is crowding office people into corners. Although the size of a computer is diminishing in relation to the increased capacity, the impact of computers is everywhere and for many people is nearly overpowering.

Over thirty-five years ago the world's first large-scale computer, the ENIAC (Electronic Numerical Integrator & Computer), was built. It weighed 30 tons, took up 15,000 square feet, and used 40,000 vacuum tubes. Today a $400 personal computer, sitting on someone's lap on an airplane, can solve the same arithmetic problems, but eighteen times faster.

A 1982 review by IDC (International Data Corporation) suggested that for each U. S. citizen 100,000 instructions were being obeyed by computers every second. By the end of 1983 IDC predicts there will be one electronic keyboard device (a total of 18.5 million) for every three U. S. white-collar workers (estimated at 55 million). By 1987 it may be a ratio of one device for each worker, with the white-collar force comprising 55% of the total workplace (54 million keyboards for 60.5 million workers).

The number of vendors with office automation products has increased tenfold in five years. A conservative estimate — over 5000 vendors offering over 12,000 different products for the automated office.

The fastest growing segment of the computer industry is in the area of portable "briefcase" computers and terminals, which is expected to multiply by twelve times in the next five years. A projection for the office automation market for the next five years (IDC in Fortune, October 3, 1983):

	Market Share 1983-1987	Expected Yearly Growth
Multifunctional Computer Systems & Local Area Networks	8 %	40 %
Copiers	15 %	- 4 %
PBX's	16 %	8 %
WP & Electronic Typewriters	19 %	15 %
Personal Computers for Business & Professional Use	42 %	30 %

The increased sophistication of the technology is making its own impact. Artificial intelligence is being used to make computers smarter, easier for the novice to use, with more sophisticated retrieval possibilities. Expert systems, using an "inference engine" of if-then rules, can scan large bases of information and provide sensible advice in areas of medicine, insurance, geology, investments, and who knows what else in the future. The technological advances in graphics, voice-storage and input systems, holography, intelligent replication (copiers, printers), optical disk storage and many other areas are providing the office manager with an extraordinary toy-shop of delights, some of which may prove to be effective solutions in the office environment.

Too often, however, we look toward technology as a panacea for the problems in office productivity. We can design a hardware/software configuration which seems to address all of the functional needs, but we can't stop there. Office automation is not just a system of multiple-functioned equipment, but an ongoing, dynamic process of combining the interactive elements of an office: people, information, functions and procedures.

In an insightful paper, "The Impact of Office Automation on Society," (1980 Office Automation Conference), Margrethe H. Olson discusses some likely results of the technological changes in our offices. The need for functional specialization in support roles will probably decrease. Access to experts will increase, leading to a greater diffusion of specialized knowledge. Electronic messaging systems can be expected to increase the upward and interdepartmental communication flows, and yet there may be a decrease in actual social contacts. The person at a workstation, as well as the consumer, may feel increased isolation due to loss of human interaction.

The personality and working style required of managers will be changed. Indications of leadership and power will be focused less on physical appearance, body language, ability to project, and more on expertise and articulate communication abilities. Decision styles will be drastically altered. Instead of working on many projects, and moving from project to project as one waits for the collection of needed information, the manager will work on fewer tasks in a day, and complete more of them. Increased productivity may be realized from the resulting reduction of startup time associated with moving back and forth between tasks and projects. If we take control of the manner in which technology is used to aid us, we may be able to reduce the strain on the biological self so that the intellectual, creative and imaginative self can enjoy maximum play.

Attitudes Toward Office Computerization

A prevalent attitude toward the use of computers in the office is based on the expressed need for greater productivity of all staff. Many units spend a great deal of time and money measuring current procedures and processes, and are made assurances of how much these procedures could be benefited by office automation. For example, a 1981 Booz Allen Productivity study of 300 managers and professionals found that 15 to 40% of their time was spent in activities which were less than fully productive: searching for information, searching for people, copying documents, scheduling, and traveling to and from meetings. The report advised that an hour a day per person could be saved using tools such as videoconferencing, document-image mail, automated information retrieval systems (for use with personal, internal, and external bases of data), word-image processing, information tracking systems, and automated calendaring.

Although many workshops and conferences are emphasizing the need to create a more productive office environment through the efficient use of the new technologies, it sometimes seems to be part of a vast marketing scheme for the benefit of OA vendors. Many of us are worried that the change of so-called "idle time" (walking to meetings, or watching the ducks) to "productive time" may be removing that critical time when our brains are sufficiently relaxed to do their best producing. Although we enjoy learning how to become more productive, we may find that it is a matter of improving the psychological environment rather than just bringing in new technology.

In a Gallup poll conducted in conjunction with the U.S. Chamber of Commerce, employee attitudes toward productivity were surveyed. The people were asked: "Which of the following areas do you think it would be possible to change so as to bring about the largest improvement in performance and productivity in most companies?" The responses (multiple responses account for a total over 100%) are shown below.

Areas Leading to Largest Performance & Productivity Improvements

Changes in:	
Worker Attitudes & Abilities	53%
Management Attitudes & Abilities	37%
Supervisor Attitudes & Abilities	21%
Quality of Tools & Equipment	21%
Innovation & New Techniques	18%
Government Rules & Regulations	12%
Union Practices	10%
New Plants & Equipment	9%
Availability & Use of Computers	6%

We shall continue to hear a great deal about how to increase productivity. Just as important, however, are the criteria of (1) improved quality of work, products and information flow; (2) better use of human resources; (3) faster turnaround of work; (4) better, faster decisions with suitable consideration of more complex factors; (5) easier completion of work; (6) enhancement of skills and increase in abilities; (7) less personnel turnover; and (8) greater job enrichment.

The motivations for acquiring new technology include not only office-directed, rational reasons focused on higher productivity, higher quality products, and other success-related objectives, but can also be based on political maneuvering, the desire for more power and control, or motivated by emotional needs, such as status or even escape.

Contrary to what some people expected, many administrators and professionals are so attracted to the new computer access that a great deal of time is spent "playing" with the new systems. The workstation holds a type of fascination, and without realizing it one can become addicted to the new "toy." An unfortunate outgrowth of this enthusiasm is the "computer authority syndrome" — charts, computer printouts, forecasts are generated willy-nilly, and the projection assurance level appears higher than reality warrants. People view documented material as valid, and forget that computer programs and output are only as good as the relationships correlated and the data input. The computer allows enormous flights of "what if" fantasy, because it makes it increasingly easy to crank out official-looking, but entirely hypothetical documents.

On the other hand, the implosion of computers into the office induces dread in many people's hearts. An estimated third of all "knowledge workers" can be expected to be wary of the VDT; one out of ten may actually prove intransigent. Resistance also develops, possibly based on: the dislike of being disturbed; fear of exposure of what is really going on; selfishness; laziness; and a natural distrust of outsiders (particularly computer personnel). It is better to view resistance as an important and useful signal, rather than an implication of bad behavior and lack of success of the new system.

Fears range from concerns about the physical work environment and social interactions to private fears which are frequently too personal to discuss. Not only is there a fear that the environment will be dehumanized with the introduction of computers, but a fear that one's own "territorial" workspace will be changed to something uncomfortable, even alien. A change of working relationships is uncomfortable, just as is any change of procedures with which one has already become familiar. Some people fear that the introduction of automation, because of its multifunctional nature, will create more work with higher levels of complexity and an imposition of greater cognitive burdens. There is a social uncertainty that one's knowledge is obsolete, that the new system may make one look foolish or inadequate. "How do I fit into the new system? Are the skills I've developed and which were important no longer useful?" A fear develops that one might find out something about oneself and one's career we'd rather not know. A middle manager may be faced with the fact that his jobs is merely as an information conduits, not a decision maker, and the mosaic of minor tasks he actually performs could be handled more accurately, efficiently and consistently by a computer. Not only will the job be different due to the new technology, but the people who work with us may be changed or even disappear. Or worse yet, one's work may no longer be necessary.

Because of the historical user views of data processing, a frequently occurring fear is that the new system actually solves no real problems, but only means a loss of the user's own control, with increased external control by the system. In addition some people feel that the cost-benefit assumptions made by the system designers are possibly invalid, and actually will provide benefits to the designers (or central administrators) at the user's cost.

The insurge of monitoring possibile on computer-based office equipment also lends credence to the ominous forecast of George Orwell's "1984." NIOSH (National Institute for Office Safety and Health) estimated that two-thirds of current VDTs are either now being monitored or could be monitored. Systems sold by Wang, IBM, Hewlitt-Packard, and DEC all have this capability. The result of knowing you are being monitored? A NIOSH study at the San Francisco office of Blue Shield showed a 2:1 greater incidence of anxiety, depression, irritability, fatigue and anger.

Issues and problem areas which the introduction of new technology may uncover are manifold.

1. Assignment of priority of tasks becomes more important. Rather than continuing the first-in/first-out approach frequently used for prioritizing in many offices, distinctions between importance and urgency need to be clarified.

2. The functions of an office worker are problematic to analyze and represent clearly. The situation, tasks, goals, and values which an office worker confronts need a better problem representation before technology can be successsfully used to improve the situation.

3. A new office automation system can present the benefits of an external memory to be used along with the benefits of the internal human mind, but the automated system too often acts as a "parent" -- if the office worker deviates from the system's parameters and procedures too much, the system asks for revision and points out possible inconsistencies.

4. The novelty of a new system wears off, especially if the office worker finds that it may take longer to do something than in the pre-technology period. The system simply may not suit the office workstyles (for example, the workstyle of an editor who does printing markups is not served well by a code-intensive, line-oriented text processor). The office worker may find that the time now spent using the system or attending to trivial interruptions caused by the introduction of new technology (message systems, computer terminals, electronic mail, an easily accessed copier) might be better spent on less urgent, but more important matters. As more technology is introduced, there are fewer and fewer people and methods to act as a screen for the office worker, and more interruptions which seem to be urgent.

In addition to the fears created by the installation of new technology, we can expect strong reactions to the long-range, large-scale planning needed to develop integrated systems. Sometimes our desire to motivate prospective users backfires — the user's expectations rise to unrealistic, unattainable levels. Another common reaction is backlash from existing subgroups who are protecting their positions and control. A third possible reaction is fear that the Big Plan will be stifling and won't provide the flexibility to take advantage of unforeseen developments or move in new directions.

Personnel Issues

As office technologies merge together, and the reality of a multifunctional workstation becomes more certain, classification and recompensation of the people working in these offices becomes a nightmare. Assigning new titles to old positions is insufficient. Completely new jobs are developing. The multiple functionality of the technology blurs the distinctions between a programmer, a clerk/typist, a data entry operator, a systems analyst, and an administrative support person. We may instead be moving toward positions more generally described as Information Specialist and Office Worker I-X.

Salaries for the new positions in many cases are remaining far below what should be paid for the actual nature of these new responsibilities. Although increased job satisfaction may help to retain some experienced staff, some surveys show already that job satisfaction for clerical workers has dropped. In addition, training programs for these new office "factotum" positions are very difficult to develop, as well as any kind of significant, reliable placement testing.

We have reason to be concerned that office information systems will create more skilled jobs and fewer opportunities for the less able. There is a gradual elimination of starting opportunities for the less skilled and less educated. Few managers want to put a $10,000 piece of equipment in the hands of a person who can not operate it deftly.

In some cases, the new technology may create jobs which are less satisfying (for example, more data entry positions). There will be less one-to-one office support, more of a hierarchical, integrated support staff, and this can deny the psychological motivations for some office support personnel to remain in that type of work.

The technological implosion into the office is forcing civil service and other personnel systems to evaluate new types of personnel programs in search of a new scheme for testing, classification, training, and salary administration which can provide for equable salaries, diagonal as well as vertical career stream movement, cross-training, and yet address seniority issues.

Ergonomics and Human Factors

Ever since the first science fiction mention of a robot, people have been concerned with cybernetics — the study of automation processes, computer control, and the interaction of computers with people. Ergonomics (ergo = work, nomics = laws of) are trumpeted as the basis of many office systems marketing spiels. The primary attention is on human engineering, but ergonomics isn't just the physical design of equipment. It is the application of human biological sciences (physiology, anthropometry, psychology, and sociology) and engineering sciences to achieve the optimum mutual adjustment of people and their work, "the benefits being measured in terms of human efficiency and well-being." (January 1961, International Labour Review: "Ergonomics: The Scientific Approach to Making Work Human.")

Although at first glance the office environment seems a placid entity, as soon as we introduce any change into it, we find a potential volcano. Lately we have seen great concern voiced by vendors, consultants, magazine editors and writers, centered on proper lighting, seating, tables, work surfaces, display screen controls, and keyboards. The ability to respond to basic psychological requirements, however, is too often dismal. NIOSH points to possible visual, muscular-skeletal and psychological disorders among VDT operators as "cause for concern." In addition to the studies being conducted by NIOSH, other groups such as Working Women are studying the long-term effects of office system technology, specifically effects of the VDT. But the resolution of the problem within your own organization lies in the hands of the system designers, analysts, and internal consultants.

Are There Any Solutions?

Glib articles in airline magazines ask: "Are you secretly, or even overtly, afraid of the computer?" "Does your office computer take you by the hand, address you by name, and pour your coffee?" Advertisements proliferate about computer camps, computer programs which help amateurs create new programs, systems which don't require even a typist to enter data (presumably using some sort of voice recognition input). This is enough to strike terror into any data processing director's soul.

What kind of solutions are there? Which are more critical, the problems dealing with personnel, ergonomics, and computerphobia, or the problems stemming from the over-zealous computerphile?

Let's first look at some reasons for information system failure. No matter how well designed technologically, information processing systems can fail because of unresolved organizational conflicts, labor uneasiness, requirement of too many dramatic changes, complicated data relationships which are not well understood, and systems which are implemented as islands of automation.

The future as many of us see it lies in "imbedded processing," access to computer power no matter where we are, with no dependence on keyboards and displays. This type of computer assisted work life has to be based on extraordinarily well-planned structural guidelines. We already see great amounts of unnecessary work being done in offices. The addition of a computer without procedural analysis and revision (including the actual purging of some processes) only means that the unnecessary work is done with terrifying efficiency.

The introduction of technology into the office workplace can be done most successfully if the user is aware that it comes at cost and with risk, and that an investment and commitment has to be made by the unit. The analyst needs to realize the technological change is best driven by a "demand-pull" from within the using unit rather than a "technology-push" from outside. All change, whether or not for a better situation, is experienced as loss. "Loss of known attachments and routines results in upsetting personal equilibrium, which in turn invokes an individual's unconscious psychological defensive strategies. Feelings of fear and a sense of lost capacity to control one's circumstances are expressed as anger, depression, sickness and/or withdrawal." (Carol T. Gaffney, "Selling Office Automation Internally," a talk at the 1981 AFIPS Office Automation Conference.) There is a loss of ministration (relationships), a loss of maturation (old rules about how to function and react to the work requirements, other people, and the environment), and a loss of mastery (developed skills, and control).

Resistance is usually a legitimate reaction which should be encouraged and responded to openly. Innovation is a dynamic process which is most successful using a trial and correction-for-error approach. Because the new technology creates a change in formal and informal communications -- a change in the very nature of the process itself, not just in the procedures used to complete the process -- the early expression of resistance should be encouraged so the system can be tailored to serve the users needs well. Technological excellence alone does not guarantee that the system is organizationally feasible.

Although thought and behavior patterns based on earlier assumptions are becoming unreliable in their ability to help us prepare for our future, there are steps which can lead to successful implementation of office information technology. Too often we find that paperwork has become important in its own right, independent of its informational content; the introduction of a few computers is expected to alleviate the resulting problems. Instead of looking toward technology as the best and only solution, we need to realize that office automation could overrun our offices before we know enough about its effects in order to sensibly control its impacts and make the technologies serve us.

Innovation is an ongoing process of experimentation and refinement. This concept should be included in all our steps of development and implementation:

Analysis: Analyze not just what is being done, but what people are trying to achieve, where the strengths and weaknesses of their abilities lie; determine what new tasks will develop; take advantage of both the technology and the people's abilities to achieve the goals of the unit.

Specification: Define not only the equipment, but the procedures and skills required.

Design: Constantly keep in mind human factors with regard to the workplace, the terminal, and the software. Create a system which is natural, responsive, supportive, expressive, rather than one which has conversations which are obscure, rude, arrogant, offensive, or boring.

Implementation: Involve the users at all levels early in the design of the system. Be concerned with the visual, thermal, acoustic, aesthetic, social, and organizational environment. Make sure that the required new skills are developed in ongoing training, with plans for both basic and advanced training.

Operation, Maintenance, and Evaluation: As ongoing system refinement takes place, it should include user group meetings and other communication vehicles so that you can provide the best interacting support.

We have a large assignment. As planners and leaders in information systems development we need to educate ourselves further about the human aspects of this incredible technological pace. For example, the work done in artificial intelligence by Marvin Minsky and Seymour Papert prompted Patrick Huyghe to write, "If we can give the computer intelligent thought, emotions and creativity, clearly the era of human beings as the measure of these things has ended." (Psychology Today, December 1983) The words of Herbert Simon are also significant -- viewing computers as "thinkers" can be upsetting "if your life is made worthwhile by the thought that humans are different."

Our goal is not office automation itself, but making our work more beneficial, and making our work environment more humane, creative and productive. Our responsibility as system designers, data processing directors, consultants and administrators is not only to be fully aware of the nontechnological impacts created by the introduction of computers into offices, but to incorporate these concerns into a carefully structured plan for distributed office computing.

NETWORKED MICROCOMPUTERS -- THE NEXT GENERATION IN COLLEGE COMPUTING

by

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The evolution of computer hardware for college computing has mirrored the industry's growth. When computers were introduced into the educational environment, they had limited capacity and served one user at a time. Then came large mainframes with many terminals sharing the resource. The use of computers in office automation began to emerge. As college computing grew, it took several mainframes to handle the workload, especially at the larger institutions. Microcomputers then came on the scene, but they had evolved back to the initial limited capacity, one machine-one user concept. They first served as personal computers, then evolved as enhanced terminals. Now, microcomputers are joining the educational ranks in networked systems, allowing more users to become part of the overall 'Institutional System,' while reducing the dependence on large mainframe systems.

Networked microcomputers are the next generation of college computing. We are on the verge of technological breakthroughs to allow maximum use of microcomputer networks. Networks allow common use of data and programs and provide a communications link heretofore not available to microcomputer users. The most immediate applications for these networks are office automation, faculty needs, and staff requirements. Colleges and universities must lead the way in innovation, especially in the area of networked microcomputers.

NETWORKED MICROCOMPUTERS -- THE NEXT GENERATION IN COLLEGE COMPUTING

The influx of microcomputers into the college and university environment is beginning to accelerate. Several schools have taken an evolutionary approach to the opportunity afforded by these microcomputers. I am not talking about just microcomputers for students, but rather as a tool for the entire institution, especially faculty and staff. The demand and reliance on computer resources at every college and university is at its all time high -- and increasing! Most students expect computer training as part of their education process. It has not stopped at students either. To keep pace with the students, most members of the faculty are requiring access and training in computer usage. To keep up with the faculty, the staff are demanding access to the latest in technology. As the snowball rolls, it grows in size.

How are most colleges and universities keeping up with the challange? Most institutions are or will eventially look into the concept of computer networks. With the growth of microcomputers, networks will be the tool to maximize the capabilities of these machines. Networked microcomputers will soon become the next generation in college computing.

Evolution of Microcomputer Usage and Data Access

Initially, microcomputers (personal computers) were used by faculty and staff at many institutions solely as stand alone devices. Microcomputers used in this way provide flexibility and portability of computing power to the individual users. In terms of overall institutional usefullness, this approach has several shortcomings. Many of the functions performed on the microcomputers are duplicated. Different programs may provide slightly different output (in form if not in substance). College data may be duplicated. Data are not transferrable or readily accessable. A stand alone microcomputer within a college or university is truly a waste of resources.

Terminal emulation hardware and software was one of the first attempts to link microcomputers to the existing data processing environment. They are available for a number of different mainframe and microcomputer combinations and they are widely used. In effect, under emulation, the microcomputer becomes little more than a terminal. Even with terminal emulation, there is still a need to transcribe and key data. In other words, emulation was a step in the right direction, but not the cure-all.

Terminal emulation's shortcomings lead to the next level, file transfer. With this capability, users can transfer the data needed from their microcomputer applications directly to and from the mainframe over the same communications link used for terminal emulation. Data can be moved from the mainframe to the microcomputer, 'downloaded,' or moved from the microcomputer to the mainframe, 'uploaded.' The ability to transfer information between the microcomputer and the mainframe increased the potential for the full utilization of the microcomputer resource, but did not maximize it. There still were problems with this approach. Large amounts of data posed a problem for the microcomputer's storage capabilities. Data transfer was often slow. Another problem arose when data was to be transfered among microcomputers; the process was slow and cumbersome. Finally, data security was a concern. If a file could be downloaded, altered, and uploaded from a number of microcomputers, how could the integrity and reliability of the data be maintained? File transfer techniques opened the door to a better approach, but had some problems and failed to employ the full capabilities and features users really wanted and needed.

Although not fully developed yet, total file interface should eleminate the problems associated with the file transfer method of data access. Total file interface will mean microcomputer users can access system files without any data transfer. Specific information needed can be accessed and processed. Users will be able to change data, access data, or add data as their security access allows. The actual programs to access and process the data will reside in the microcomputer and the microcomputer will be doing the actual data processing. Total file interface will revolutionize the use of microcomputers in networked environments.

Defining Microcomputer Networks

Microcomputer networks are being created to meet the needs of users with a large number of microcomputers and the communications needs of that environment. Currently, there are two methods being used and developed to network microcomputers. Neither method is fully developed at this time to enable microcomputer users maximum utilization of their resource. The methods are:

1. Pure microcomputer networks, and
2. Mainframe-based networks.

Pure microcomputer networks are communications links that connect a large number of microcomputers and other peripheral equipment and storage devices. They usually include:

* Communications cards, containing communications software used to control the entire network
* Storage devices, including winchester disk, cartridge tape, and floppy disks
* Printers, plotters, and other hard copy media.

When part of microcomputer networks, individual microcomputers do not have to have a floppy or hard disk capability. Program and data libraries are maintained on the systems disk storage. Peripheral and storage devices can either be dedicated to one user or can be system resources. Total file interface is available in some pure microcomputer networks.

Currently, these types of networks are being used by several colleges for instructional use. Some schools are also using this concept for administrative data processing. The system requires a communications network, such as Ethernet or Arcnet. These networks support both hard-wired and dial-up capabilities.

The advantages of the pure microcomputer network include:

* Low initial cost. From the user's side, only a microcomputer, keyboard and monitor are required to fully use the system. The communications network, storage devices, and hard copy media are system requirements that are relatively inexpensive and readily available. Several firms package the systems or they can be built using off the shelf components. Compilers, data base management systems, word processing software, application systems, and all other software is available to all users. This 'shared' concept can save money in software purchase and training and can increase compatibility.

- Centralized data storage. Storage devices are usually system reso[illegible] thereby providing central data storage. This includes program libraries and data files. Users use the same programs and may (with proper security codes) access central data.
- Unlimited expansion. Some networks have a theoritical limit of 32,768 devices (although I am sure the practical limit is somewhat less).

The disadvantages of this approach include:

- Limited disk capacity. Winchester disks have limited capacities, although they are increasing. Currently, the largest single winchester disk is in the 300 MB range. If there is a need for data bases larger than this, different file handling methods are required.
- Limited vendor support. There are few vendors that produce and support this approach, although the number is increasing.

The mainframe-based networks rely heavily on the central computing capability or on another central processor. Here, the mainframe acts as the system controller and data manager. Microcomputer programs access the data, stored on the mainframe's disk, as if the data were on the microcomputer's own disk. One way to do this is by creating 'virtual diskettes' on the mainframe's disk. The user creates the 'virtual diskettes,' formats them, and reads and writes on them. Files created on the 'virtual diskettes' are marked to allow or disallow shared access. The disadvantage of the 'virtual diskettes' is that it is difficult to access the data from the mainframe or from microcomputers that require differently formated diskettes.

The ultimate capability is for the microcomputer to be able to access data using the total file interface access method as stored on the mainframe's disk and use its microcomputer capabilities to execute the programs and minipulate the data. In this manner, the host mainframe and media-incompatible microcomputers can access the data, given the proper security, as if it were a standard mainframe file. Unfortunately, no mainframe has this total file interface capability yet.

The advantages of this concept are:

- Centralized storage and control. Since the mainframe acts as data manager and system controller, all data is centralized. Strict security measures are maintained for access and alter capability.

- Data compatibility and accessibility. Data are compatible among the microcomputers and the mainframe and accessible by all authorized users.

The disadvantages of the mainframe-based network approach are:

- Cost. Relatively speaking, mainframe computers and associated peripheral and storage equipment are expensive. Software to support a large network can also be expensive.

- Different mainframe manufacturers maintain different communications standards. There are numerous communication protocalls for the various mainframes. This is compounded by the number of microcomputers on the market. If the microcomputers and mainframe are from the same manufacturer, this problem disappears, but individual users are locked out of other microcomputer alternatives.

- No system incorporates the total file interface design yet. Vendors are getting close, especially third party communication and data base vendors. As standards are developed for communication protocalls or third party software vendors overcome the incompatibility and total file interface problems, the concept will become reality.

Several colleges and universities are approaching the solution from a mainframe-based network. These schools are generally setting the standards or dictating the microcomputer that will be used to reduce communication protocall and data storage incompatibilities. Usually, the standard revolves around the mainframe manufacturer's network software packages and capabilities.

Building a Successful Network

College Information Resource planners must comprehend and examine a number of separate issues when planning for and building a microcomputer network. The most important of these include:

- Standardization of the microcomputers
- Data security and integrity
- User interfaces and training
- Communications type and environment.

The first key consideration in building a successful microcomputer network is to ensure the microcomputers used are not so diverse as to make interconnection imposible. If the devices on the network are too diverse, numerous problems will emerge. Most colleges and universities that are working toward this concept have designated the brand selection that will be the standard. Many times the microcomputer operating system will be designated and all microcomputers on the network will be required to run that operating system while on the network. Even with so called "all connective" networks, problems will occur. These problems will mainly involve less popular equipment, which the manufacturer or third party's network interface was not designed to handle. The institution must take the initiative and set the standards for use on the network.

Data security and integrity is the largest organizational problem for a college or university in the use of microcomputer networks. Obsolete data, theft of data, and unauthorized access are some of the problems. Each concern is magnified as the number of users with access to the network increase.

Many college and universities with dynamic data bases are concerned that decisions will be made on data that has changed in some proportion since it was downloaded from the mainframe computer. Users should be aware that data is being constantly updated and may be subject to fluctuations. While microcomputer networks allow the users to have access to the latest data, they must be aware of the problems and responsibilities of this access. Total file interface will solve this problem.

Theft of data has always been a problem for colleges and universities. In the past, worries were isolated to the data center itself and to those who could see and/or print information. With microcomputer access, and the ability to store and manipulate data on the microcomputer, a greater potential for theft exists. Now, theives can steal data, manipulate it, and produce results not previously available. The remote and unsupervised operation of microcomputers on the networks add to the data security problem.

The one area that is improving with the development of networks is that of unauthorized access to data. It is unlikely that a data base that was previously secure against intrusion will have a problem solely because of the presence of microcomputers on the network. Most networks and data base software maintain a good password access capability.

Most of today's microcomputer user's applications are stand-alone. Networked microcomputer systems will not change this. The microcomputer user needs the network to access data, communicate with other users, and access other files (e.g. program libraries, etc.). The network becomes the interface among many users. The problems of designing the interfaces and training the users in the use of communications will be a major hurdle in the effective use of the hardware/software systems being built. With few exceptions, colleges and universities will purchase the network software that will be used. Included in that software will be the user interfaces. Care must be taken when evaluating and selecting the network software and in training the users. Microcomputer networks should not be 'user friendly,' they should be user transparent!

The communications type and environment that will be used will depend on the institutions needs and requirements. Most institutions do not have the talent in sufficient numbers or time to develop their own communications environment, they will probably purchase a third party's package or use the package available on the mainframe they are using. As microcomputers proliferate, microcomputer networks will be developed and appear on the market. To ensure that the network communications scheme is well received and put to use, applications with broad appeal to the user community must be implemented. The Information Resource planner must appreciate the needs of the faculty and staff in specifying the requirements of the network communications software.

Focusing on Needs

Applications with broad appeal to the user community must be the first implemented. This means applications should be oriented first toward:

- Office automation
- Faculty needs
- Staff requirements.

Office automation is usually the first application that is implemented on a network basis. Office automation includes access to information, communications, document generation, personal computing, and personal management. Office automation functions are usually justified through an increase in productivity.

Access to accurate and timely information is one of the primary advantages of the microcomputer network concept. By creating networks, individual microcomputer users will have access to the needed information in an understandable format. It was previously noted that the total file interface concept will be the next data access method for microcomputer networks, but it is still under development.

Communications include person-to-person, person-to-group, group-to-group, person-to-computer and computer-to-computer. Progress has been made in the person-to-person and person-to-group areas with electronic mail. Computer-to-computer and person-to-computer communications has been possible, with some constraints, for some time now. Group-to-group is still an emerging area, although teleconferencing is beginning to fulfill its potential.

Document generation includes word or text processing, but will go far beyond the simple clerical tasks most people think of today. Professional faculty and staff will find it easier to input text, especially internal documents, than to hand write them. Now graphics allows a new dimension in portraying data. Image processing (photos, drawings, and signatures for example) is emerging. Voice recognition is being used by some companies and will be available in the not too distant future. The creation of integrated documents will require extensive data access capabilities and compatible communications networks. Microcomputer networks can combine all areas of document generation into a single useable system.

Personal computing, the fourth area of office automation, will be used by clerical personnel as well as professionals. It will allow users to run or access a wide range of programs at their desk, with access to the data needed. Programs currently associated with microcomputers (e.g. spreadsheets, etc.) will continue to be used, but technical programs and mainframe programs will also be available.

Personal management will be the final area included in office automation. This capability includes calenders, schedulers, and electronic notebooks. Users who find these techniques of value will adopt them quickly, while others will take longer to recognize their advantages. Again, the use of microcomputer networks will speed all the office automation functions along.

One last comment on office automation. Applications should be available for all users, but all users will not necessarily use them. Applications should be used by individuals according to three criteria:

* They should be used at least once daily

* They should be an automated replacement for a manual task

* They should be understandable and users must receive the appropriate training.

Faculty needs are the second set of applications that should be a part of the network. Faculty applications include the availablility of office automation tools, support for research, and tools for increasing teacher productivity. Not much more can be said for office automation. Faculty will use many of the applications available in this area.

Support for research will include the technical, data gathering, and data storage and handling needs to support the research efforts of faculty members. Statistical packages must be a part of the network. Microcomputers will be a big aid in supporting the data handling and minipulation needs of research.

Finally, tools for increasing teacher productivity will be part of the college or university microcomputer network. Examples of faculty tool are computer-aided-instruction and computer-managed-instruction. With the abundance of widely used microcomputer applications, teaching programming will become secondary to teaching application usage to most students. Tools must be available to assist individual faculty members to create automated teaching aids, assist in grade retention, filing and computation, and in record keeping and reporting. Use of the network will mean all faculty members access and use the same data bases and programs to increase consistancy among faculty members in record keeping tasks.

The final focus will be on staff requirements. Areas such as institution research, decision support, alumni and development, and job placement are just a few examples. Many of these applications are computerized now, but their inclusion in the microcomputer network will enhance their usefullness. As with the other applications, access to college or university data will expand the ability to perform these tasks. Use of the microcomputers will maxamize the ability to locally manipulate the data and provide meaningfull output in forms most useful to the ultimate user.

Summary

The use of microcomputers in colleges and universities has come a long way since the days of stand alone processing and there are more improvements to come. Because of their potential in everyday life, microcomputers are here to stay. It is inherent for colleges and universities to take the lead in the use of microcomputers. To that end, networked microcomputers will be the next generation in college computing.

All the tools, however, are not available now. We are on the verge of technological breakthroughs to allow maximum use of microcomputers in the networked environment. Common data and programs and the communication link between microcomputers and possibly one or more mainframes, provide the real advantages of microcomputer networks. Yes, there will be problems, but those problems will lead to opportunities and those opportunities to innovation. Colleges and universities must keep pace with industry to better prepare students. Industry is marching toward communications networks that will link managers' and professionals' microcomputers to each other and to the corporate data bases. What better way to incorporate the innovations of the future than to advance toward networked microcomputers as the next generation in college computing.

THE IMPLEMENTATION
OF THE
EXECUTIVE NETWORK AT THE MARICOPA COLLEGES

By Ronald Bleed
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Exactly one year ago, a new system was implemented at The Maricopa Colleges. It started with the implementation of a terminal in the office of the Chancellor, then the three Vice-Chancellors and the seven college presidents. The purpose of this paper is to describe the effect upon an organization and individuals in a computerized executive network.

First, I would like to give some background on The Maricopa Colleges. In the Maricopa system, there are seven colleges located in the Phoenix metropolitan area. These colleges enroll 70,000 regular college credit students per semester. This makes the Maricopa system the third largest community college system in the country. This enrollment equates to approximately 32,000 full-time students. In addition, there are from 30,000 to 50,000 non-credit and special interest students. The name Maricopa does not have a large name recognition factor. However, the names of the colleges may be more familiar. The seven colleges are: Phoenix College, Glendale Community College, Mesa Community College, Scottsdale Community College, South Mountain College, Maricopa Technical Community College and Rio Salado Community College. Besides large numbers of students, Maricopa takes pride in being a national leader in educational innovation.

During the past one and one-half years, Maricopa has made major strides in computer services. First, a network of six DEC VAX 11/780s were purchased to support the academic process. Most of these machines supports approximately 60 academic users. Because of this expansion in computer resources in the past two years, there has been a 40% increase in enrollment both years in data processing courses. Along with the existing equipment, a Prime and a NAS, the number of terminals available to students has increased from 84 to 400. Secondly, a large number of microcomputers were also purchased to support academics. During the past year, over 300 Apple IIes, over 50 IBM PCs, over 50 TRS-80s and over 50 DEC microcomputers were purchased. These systems are used primarily to support multiple disciplines in an open laboratory situation. Thirdly, 150 word processors were also purchased to support the academic office automation function. Fourthly, three smaller time sharing networks were also established at some of the colleges. This all adds up to an increase of nearly 1,000 work stations for academic use during the past 18 months.

To support the academics, several innovative approaches were taken. A faculty literacy project was developed. In this project, every three months 50 faculty members receive an Apple IIe computer to take home. During the three month period, they are required to attend a weekly workshop which teaches them how to use the system. A heavy emphasis is made on the teaching of tools on the Apple. Such topics as spreadsheets, word processing, and authoring languages are heavily emphasized. At the conclusion of the three month period, another group of 50 faculty go through this program. The faculty who have gone through this program have highly endorsed this type of education. This program has created a great demand by these faculty members for increased computing in their department. The faculty who are selected for this program were selected from across all disciplines.

An important strategy has been to decentralize the computing from the District office to the colleges and at each college out into the departments. This has meant that efforts have been made to make sure that these systems can form sub-networks to the larger networks. The Apple computer has very effectively communicated to the Vax network. The word processors also communicate very easily to the larger network. The capital plans of the District have sufficient funds to continue this rapid expansion of microcomputers and time-sharing networks.

During the same period of time, complete changes took place in administrative computing also. During the past year, all new administrative systems have been implemented by Maricopa. All old systems, both software and hardware, were completely discarded. To accomplish this, Maricopa entered into a three-way agreement with DEC and Information Associates to use the Vax on the new Project Z software. Maricopa was the pilot site and has implemented all systems in Project Z. Substantial programming has been done by the Maricopa staff to supplement the administrative systems. On July 1, 1983, all systems including payroll/personnel systems, the accounting systems and the student registration systems were implemented. The payroll/personnel system prints approximately 7,000 payroll checks every two weeks and has flexible fringe benefit components. The accounting system handles all the financial transactions. All registration for the colleges was done on the new system during the summer for the fall semester. Most of the users of the registration system were using an on-line system for the first time. With this system, over 100,000 students were registered during this period of time. The new system is almost completely on-line and integrated to a large degree. The student information system was decentralized to each of the college computers. The identical programs are executed at all seven colleges although each college does registration differently. The payroll/personnel system and the accounting systems reside at the central computer in the District office. The exception is the financial transactions sent to it from the student billing and receivable system from each of the colleges. All systems are linked together by DECnet, and information from any of the systems can be routed quickly and easily from any of the colleges. All program maintenance is done out of a central office. Changes are downloaded through the network to the individual colleges.

The purpose of this paper is to describe the executive network that is used to supplement the previously mentioned systems. I would like to emphasize two themes during the rest of this paper. First, is what I call "the top-down" strategy and secondly is that office automation is more than a by-product.

During the procurement process in bidding for the new computer system, Maricopa was looking primarily for a new system that could support large numbers of student users and one that could implement all major administrative systems in an on-line mode. Mentioned in the bid specifications was office automation with some details associated with that system.

An evaluation matrix was established with a total of 1,000 points. This matrix had points for hardware, operating systems and application software. Included in the points for application software were 70 points for office automation systems. This represented 7% of the total points available. At that time, we were concerned with office automation but did not give it all the weight it deserved. In fact, DEC, the winning vendor, actually was rated low in office automation but had so many points in other areas that it still won the evaluation process. What had happened was that DEC had neglected to sell some of their significant products that they had. We then became aware of products such as DECmate word processors and the Charlotte Office Automation System. These were some of the best kept secrets of DEC, but eventually we ended up with superior office automation products.

When we fully realized the potential of their products, we decided to implement a complete electronic mail system in addition to all of the other major administrative systems. At the same time, this Charlotte system of electronic mail and office automation moved from a regionally supported product within DEC to a corporately supported product called All-in-One Office System. Maricopa became the first major user of that system.

There were several reasons for us to become interested in electronic information systems. First, Maricopa Colleges are widely geographically dispersed within the Phoenix metropolitan area. Second, because we are an educational institution and continuously had people in meetings and classes, etc., telephone tag was a real problem among the staff of Maricopa. Only one of four calls were getting through. Third, the issue of computer literacy was becoming important and the strategy was to immerse people into computers as soon as possible. The first system that could be installed was the All-in-One system, and this would permit the executives to get their hands on terminals and work with the computer. It was hoped that hands-on experience would lead to a more computer literate group. Fourth, the All-in-One system could be delivered immediately, whereas, the other administrative systems were a year away from implementation.

The office automation system had moved from being only a by-product to being the first major system to be implemented, and its importance grew daily. Actually, the first people to use the system were the computer service department who all had terminals at their desks. They also were people more willing to tolerate some of the early problems in system implementation. Soon after they had successfully used the system for a couple of months, a deliberate strategy was undertaken to put the executive network in the office of the Chancellor, Vice-Chancellors and college presidents. This is what is meant by "the top down" approach. These executives never before had a terminal in their office. Thanks to the donation of color Gigi terminals from DEC for the purpose of placing them in executive offices, these people were the first to receive terminals. Thus, the first person outside of computer services to use the new computer was the Chancellor himself. The Chancellor immediately issued a policy statement toward the direction of paperless offices and that he would be willing to receive messages primarily in electronic form. He discouraged the use of paper memos. Training sessions were held and these executives began to use this network. As additional equipment began to arrive, the number of users began to spread down the organization. Now it is down to middle management users.

Because of the success of the network, executives were given systems for their homes along with their offices so that they could communicate and extend their workday from their homes. In addition, their secretaries were given a word processor that had terminal capability and access to the same network. The executives were all linked together on the network at work, at home, and with their secretaries. The types of equipment each had were a DEC Gigi terminal for their office, a DEC 350 Professional microcomputer for their home, and a DECmate word processor for their secretarial office.

Maricopa is governed by a locally elected five-member board of trustees. It was decided after the successful executive implementation that each of the members of the Governing Board should also have access to the network from their homes and they became members of the network. They received a DEC Rainbow microcomputer.

An interesting development of the executive network is that a member of the executive network is the president of the faculty association. Maricopa has a strong faculty organization that is used in the bargaining for salaries and benefits. This group is part of the government structure of the colleges.

What are some of the uses these executives made from the network? The heaviest used part of the system was electronic mail messages. The way the system is organized is that they were able to send messages to individuals or to groups of employees through the system. Closely related to electronic mail was the electronic file cabinet. They were able to input into their file cabinet the messages they wanted to keep on a more permanent basis. These messages could be stored by subject, keyword and topic. Documents created on the DECmate word processors could be transferred into this system and filed. Another use of the system was the calendar management system.

Today only some of the executives keep their calendar electronically. If more did, the system provides for the automatic scheduling of meetings and tickler files for activities during the day.

Other uses of the system have been word processing, and the preparation of graphics. Several executives have used graphics to prepare slides for presentations. Through use of a graphics editor, these slides can be easily prepared. Many of the speeches our executives have given at national conferences have been accompanied by computer-produced slides from this system. (The slides that accompany this paper were done with this system.)

The largest potential use is to be able to access the administrative data files. Looking at the status of accounts, the preparation of the budget and checking enrollments are important to these executives. The additional tools of spreadsheets, personal filing systems, data based systems, etc. are just beginning to be used.

In her dissertation for Arizona State University, Jacquelyn Miller researched this network. As a result of her study, she reported 18 major findings and several conclusions.

1. The executive's keyboarding skills do not play a role in the level of use of the office information system or the length of messages.
2. Executives learn the equipment best during a hands-on training session, rather than through a demonstration on one computer or reading the manual.
3. Executives learn the functions of the system on a "need-to-know" basis. They prefer consulting with a resource person to group training.
4. Secretaries become anxious when they do not receive their own equipment for several months after training.
5. Secretaries are reluctant to attend training sessions in physically uncomfortable environments or for long durations of time (four to five hours).

6. Executives and secretaries become confused and feel overwhelmed when presented with an overabundance of information during the initial training stages.

7. Executives view the computer as a management tool. They become impatient if the response of the computer is not instantaneous. They resent reading messages that are frivolous or that are lengthy and technical.

8. Microcomputers in the home free the executives to work outside the office or without using the telephone to communicate with colleagues.

9. No systematic approach for the retention and destruction of documents in electronic or hard copy form had been devised.

10. A noticeable reduction in the number of internal telephone calls and written messages resulted in the network.

11. The fact that secretaries no longer act as "gateways of information" for their bosses is not a matter of concern.

12. Secretaries are reluctant to read and file the executives' electronic messages.

13. Secretaries foresee their roles and responsibilities changing in the future. They prefer assignments involving a higher cognitive level of thinking.

14. An executive's average action is brief, lasting generally less than ten minutes. Seldom does the executive concentrate on only one task at a time.

15. The use of the network did not reduce the numbers of scheduled meetings among the executives.

16. The amount of information discussed at the meetings was greatly reduced, as was the length of the meetings.

17. Executives view the creation of an electronic network as a personal way in which to communciate and develop a feeling of cohesiveness among colleagues.

18. The key factor in guiding the organization through the transition period of manually processing information to electronically transmitting it is the chief executive officer's total commitment to using the office information system.

The method in which users are trained is a critical component in the implementation process of office information systems. Unless the user has immediate access to equipment and can learn the functions of the equipment simultaneously with the explanation of the system, training is of little value and leads only to increased confusion and self-doubt.

The acceptance of the computer as a management tool rather than a toy is another key factor in the executive's willingness to use the system.

The establishment of a network of users and the consistent use of the computer to transmit information will determine the success of total participation by all users.

The network allows the executive more discretionary time by reducing the amount of time spent in meetings, placing telephone calls, and relying on the mail system.

Educational institutions training office employees will need to emphasize keyboarding, organizational, and analytical skills.

The opportunity to accomplish work outside the office through the use of the microcomputer offers more flexibility and freedom to the executive's working style.

The reactions to having microcomputers available for home use ranged from a flat refusal to enthusiastic constant use. Three executives expressed the feelings that they worked enough hours at the office and resented the obligation of having to do more work at home. Two executives refuse to turn on the computer during the weekend unless they are leaving town. The remaining six executives did not feel that the presence of the computer necessarily extended their normal working day. (As they already put in the same number of hours without having the computer.) They found they prefer using the computer at home during periods of low use in order to get a quicker response rate from the system.

The major advantage to having the computer in the home, according to the executives, is the ability to accommodate each individual's particular working hours, thus encouraging creativity at any time, day or night. Seventy-three percent of the executives were enthusiastic about working at home on the computer, utilizing the word processing program to create speeches, reports, and articles for publication. They found the home a more relaxing, creative environment. Three executives expressed their surprise on getting an immediate reply from colleagues over the weekend or late in the evening. They do not expect to find others working on the system at the same odd hours as they are.

One user commented, "It's much more fun at home and I have more of a sense of accomplishment." More work is done with the computer than had been anticipated. Many administrators also produce documents and send them electronically to their secretaries, who will then begin working on them the next working day.

The executives were relieved to find that in case of illness work can still be done at home; and information can still be communicated through the electronic system. Much of the pressure of responsibility is lifted when such flexibility is available to them.

The executives reported that the quality and quantity of information received has not changed but that they are getting the information in a more timely manner. One executive stated, "The information coming across the screen is more credible and has more of an impact than if it were to be received in paper form." This executive dislikes receiving paper documents, which he considers bothersome and not as easy to handle as electronic communications.

A common assumption concerns the executive becoming too isolated from his/her staff as a result of spending a great amount of time using the computer. During the interview process, the researcher found this assumption to be inaccurate from the executives' perspectives. One president commented, "I feel this system brings me closer to the others and makes me much more knowledgable about what is going on." All the presidents consider themselves highly accessible to the other administrators, staff, and faculty on their campuses. The majority of them, however, seemed to contradict that statement by admitting that their staff probably did not share those same feelings. One president remarked, "When I'm on campus, I'm available to any staff or faculty member; but I spend a great amount of my time away from the campus."

The presidents remarked on a greater feeling of cohesion amongst themselves as a result of the freer flow of communications that the network has allowed them. They reported that a great deal of time is saved by eliminating the process of transmitting information through the secretaries and the mail system to get information to their colleagues. The assurance that messages are reaching their colleagues has allowed them more opportunities to walk around the campuses to visit with faculty and staff.

The use of the telephone was viewed as a continuing method of communicating confidential information. All the executives reported that confidential information was not sent over the electronic mail system and was not written. Information of a sensitive nature was usually discussed away from the premises or via the executives' private telephone lines.

Each executive conveyed a sense of confidence that the information would be received instantly. Lack of frustration in repeated phone calls to relay information was evidenced during the observations.

In response to a question about any changes in decision-making patterns, all the executives stated that no major change had taken place in the way in which decisions were made. Accessibility of necessary information meant that decisions could be made more expeditiously.

Several administrators mentioned that a major advantage of the network system is the freer exchange of information and opinions among themselves, a positive step that had not been possible prior to the implementation of the network.

Some of the fears regarding electronic mail have not materialized. At first, there was fear that subordinates would not follow the normal chain of command and would issue electronic messages to higher ranking executives without going through their superior. That has not happened. Another fear that did not materialize was that there would be a flood of memos. It is true at first that users tend to be somewhat more frivolous with their messages just because of the experience of doing it for the first time and they are likely to send out "have a good weekend" type of messages. However, as they gained maturity, there has been a definite trend toward much more business-like messages.

Another significant factor has been that personal relations have not been reduced because of electronic communications. In fact, they may have been improved. What happened is that less time is spent in communications that can be answered quickly and more time can be spent in communications that require the indepth interpersonal communications. For example, a subordinate will come into an executive office with a quick question that needs a quick answer. To be courteous, some preliminary conversations need to take place. The final result is that it takes several minutes to answer the question by having the person come to the office. However, if the question had been sent electronically, the answer could have been given very quickly and effectively. It has been substantiated that the length of meetings and number of agenda items has been decreased by 50 percent because of the executive network.

Another important factor is that information does move much more rapidly throughout the organization. In the Maricopa situation, where paper would take at least a day or more by mail truck to arrive at another college, or telephone tag problems could take even longer, the electronic communication is received much more rapidly. A surprising development has been that the messages are perceived as less threatening. The receiver can deal with the message at his own pace and have time to reflect on the answer. When a question is asked face-to-face, a different response may be generated.

Another major use of the system has been the installation of the Legislative Information Management System (LIM). This system is an offshoot of the concept of "Issues Management". What is done is that all of the legislative bills that affect higher education in the state of Arizona are tracked and updated almost daily with the status of the bill, the sponsors, the way the votes apparently are going, the legislative leaders involved who should be contacted and finally a summary or position that the District is taking toward that bill. If a question should arise to a member of the District from an outside source as to what is the District's position, the bill can be interrogated on the screen and the official position given to the inquirer. This provides a much more consistent answer throughout the District. In addition, LIM can inform as to the progress of some of the bills and to which ones should be pushed along with political influence. This system was created by using the standard All-in-One filing system. No additional programming was needed to incorporate this system. Additional issues can be coded in such a fashion and maintained. It is the responsibility of the External Relations department to maintain this system.

Future uses of electronic mail systems are to connect it to the universities in the state of Arizona, particularly Arizona State University. There is a large need for Maricopa to communicate on an executive level to the universities. The technical incompatibility between DEC and IBM is the bottleneck but it is being addressed.

Currently, there are 160 users district-wide with the All-in-One system. These people have special accounts in order to use that system. Also, with the network, there is a VAX mail system for anyone who logs into the system, including students. Although this system can generate messages more quickly, it does not have all of the bells and whistles of the All-in-One system. All-in-One is restricted to key administrative users only.

To summarize the main themes of this paper, first, the executive network was incorporated in a "top-down" method. This is the best way of guaranteeing success. The payoffs are also greater. When you consider salary level of the top executives, any small percentage of improvement in their efficiency will help pay for their equipment in a fairly short period of time. Nothing adds credibility to a system as support from top management. Subordinates fall in line almost without question. There are very few reluctant users to the system. It is also hoped that the information that will be delivered to the executives in their offices will lead them to making the proper decisions that have major effects upon the institutions.

The other theme is that office automation is much more important than a by-product system. It has become a major system within Maricopa and a major value to the District. It is worth much more than the original 7 percent part of the system. In analysing the usages that are being made with the VAXs or microcomputers by faculty or by administrators, the office automation application is the single major use of the system now. In surveys being done of business and industry, word processing emerges as the number one use on the micro-based systems.

Judith Leslie of Pima Community College, has published an interesting paper titled "Does Your President Keyboard?". In this paper, she suggests that the vitality and future of an institution depends on the answer to that question. At Maricopa our executives do keyboard and they are leading our colleges to relevance and excellence.

IMPLEMENTING OFFICE AUTOMATION IN POST-SECONDARY EDUCATIONAL INSTITUTIONS

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ABSTRACT: The implementation of office automation in institutions of higher education requires positive management commitment and action. In most institutions, there are growing numbers of microcomputers used for personal computing and instruction, for supporting secretarial and clerical activities, and providing executive decision support systems. This explosion has usually not been monitored or controlled--indeed it is largely invisible to those levels of management which determine major policy. This paper identifies three implementation strategies for office automation and decision support systems within post-secondary educational institutions: "natural evolution," "the total solution," and "coordinated evolution," and discusses the components of an effective implementation plan.

IMPLEMENTING OFFICE AUTOMATION IN POST-SECONDARY EDUCATIONAL INSTITUTIONS

If an institution of higher education is to gain the advantages offered by the new technology of microcomputers and by the new concepts of the automated office, it must develop a prudent, but effective, strategy for implementing them. Ignoring these new developments will lead to chaos and frustration.

There are three basic strategies for implementing office automation within any organization, including institutions of higher education:

* Natural evolution

* The "Total Solution"

* Coordinated evolution

Each of these strategies has its advantages and disadvantages, and the one chosen for any given organization must depend on the needs and conditions within the organization.

Natural Evolution

Unless an organization is impoverished, natural evolution toward integrated office automation will occur. As managers, persuaded by advertising and the experiences of colleagues, determine to acquire microcomputers, they are developing office automation. Often, managers will finance the acquisition of microcomputers themselves, recognizing that the impact may be measured in terms of self-satisfaction as well as organizational efficiency. Word processing equipment, on the other hand, is typically funded by the institution itself.

The chief advantages of this approach, from the institutional perspective, are that:

* It requires a minimum of central direction from the organization's management

* It ensures that there is a strong commitment from the local users who either finance the systems out of their personal pocket or, at least, must direct their local budgets towards acquisition and support of the equipment

* It allows the gradual emergence of a series of systems which are tuned closely to the exact needs of the organization

* It (probably) ensures efficiency in the expenditure of organizational funds on office automation since expenditures are determined completely by the users' assessments of their actual, immediate needs

On the other hand, the natural evolution approach has several significant disadvantages:

- It leads to the acquisition of many different, non-compatible systems
- It encourages the acquisition of undersized or inappropriate systems selected because of funding reasons
- It fosters poor implementation decisions because local users lack the expertise or time to investigate alternatives and make appropriate decisions
- It prevents the development of an efficient communications network
- Depending on the mainframe computing environment of the organization, it may decrease the effective integration of the local office automation equipment and the central institutional databases

The biggest advantage of the natural evolution strategy is the likelihood of user commitment, while the greatest disadvantage is the lack of compatibility and communications between systems. Depending on the organization, the disadvantages may be relatively unimportant.

The "Total Solution"

The most common approach to implementing office automation in a large organization is to implement the so-called "total solution." The "total solution" usually involves a major commitment of institutional resources to the acquisition of equipment and systems from a single vendor. Building from the base of the mainframe (often the implementation of the "total solution" involves the acquisition of a new mainframe to "support" the "Office Automation System"), the institution implements a complete communications network, with appropriate distributed processors and work stations throughout the organization.

Such a strategy usually follows at least a year of careful planning and evaluation, and when properly done involves many, if not most, of the organization's managers and supervisors as part of one or another committee. The organization prepares a multi-year implementation plan, allocates substantial resources, and then contracts with a vendor to implement the system. This approach is most often recommended by vendors because it indicates a strong commitment at the highest levels of an organization to office automation, and thus indicates that there is a strong financial base for the implementation program.

There are a number of advantages to the implementation of a "total solution" approach to office automation:

- It indicates long-term, consistent support from top management

- It maximizes the degree of coordination and compatibility among local systems and with the mainframe
- It fosters the implementation of an efficient and effective communications network
- It ensures that the office automation will in fact be implemented throughout the organization
- It encourages the most efficient expenditures of funds
    - Incorporates large-scale negotiated contract with vendor
    - Prevents unnecessary duplication of equipment in neighboring departments
    - Employs technical experts in the planning and decision-making processes
    - Permits efficient training programs
    - Permits maintenance procedures and contracts for the institution as a whole
    - Maximizes utilization of shared resources
- It provides confidence for low-level managers to implement office automation even if they fear that their supervisors may be hostile to innovation
- It ensures strong vendor cooperation in the development and implementation of the new system

There are also significant disadvantages to the "total solution" approach to office automation:

- It may conflict with decentralized management and control within an organization
- It may result in antagonism towards central management
- It may fail through lack of local user commitment
- Decisions may be based on politics or image rather than on real functional needs
- It requires a large outlay of capital funds, identified early in the process
- It reduces flexibility in the implementation process as the organization and users gain experience with office automation in their environments
- It may be insensitive to distinctive functional needs within specific divisions and departments
- It may not recognize priorities for other projects within local divisions and departments

The chief advantages of the "total solution" approach come from the fact that it assumes that top management in the organization will provide the resources (both human and financial) to ensure that the project succeeds. But that same element of strong central control can be the greatest drawback as well, since it may be (or be perceived) that top management is "heavy-handed" and insensitive to users. Furthermore, decisions made by top management may not necessarily be endorsed (or enthusiastically supported) by lower-level managers and supervisors. It should be noted, however, that, from the vendors' perspectives, the implementation of the "total solution" is the most attractive approach, and it is the one they most often propose.

Coordinated Evolution

Between these two strategies lies the strategy of coordinated evolution. The decision-making is still largely left to department and division managers, but the organization's top management ensures that all decisions fit into a broad plan for office automation which includes networking and interfaces with the mainframe. A central coordinating group must review all decisions for the acquisition of office automation equipment, and work with individual users to ensure that the systems are both appropriate in function and compatible the long-range institutional plan. This central coordinating group must have access to technical and system consultants who can ensure the technical validity of local user decisions.

The central coordinating group must develop a plan for the ultimate configuration of the system, and define the functional specifications which must be met in terms of communications, integration with the mainframe, and document distribution. It will be necessary at an early time to define the acceptable systems to ensure complete communications compatibility.

While local users may make individual decisions, the central coordinating group must look for opportunities to maximize the impact of funds through joint projects. In addition, most expenditures on networking must come from the central coordinating group to ensure an efficient final network configuration.

If effectively coordinated with a strong commitment from top management, the coordinated evolution approach should have most of the advantages of the other two strategies while mitigating most of the disadvantages.

Perhaps the biggest difficulty will be in dealing with vendors, who will tend to either fragment office automation into office level units or argue for a "total solution" approach. Since coordinated evolution requires a strong commitment by local users and the incorporation of their needs and their already existing equipment, the final configuration must provide for a high degree of flexibility. Because the acquisition process will be rather decentralized, individual units must be available for reasonable marginal costs--clearly the organization itself will have to augment funding for communications and major distributed processing devices.

Within most institutions of higher education, this coordinated approach will be most effective. It emphasizes the collegial climate existing within education while encouraging sound management. Let us turn now to a more specific discussion of the process of implementing office automation.

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The most important task is the development and subsequent execution of a specific four year Implementation Plan for Office Automation. The creation of such a plan, however, can occur only after some preliminary education. The highest levels in the institution may understand the value of office automation, and make a commitment to it. To accomplish this requires a preliminary education phase -- presentations to the President's Cabinet and, perhaps, the Board of Trustees. Such education must be implemented with a prudent eye toward the political realities of insitutional governance.

The Implementation Plan itself plan must address at least eight issues:

Policy and Procedures

* Definition of functional specifications
* Definition of communications specifications
* Definition of functional relationship between office automation and administrative systems

Technical Implementation

* Selection and/or development of appropriate hardware and software systems
* Definition of the network configuration for a mature office automation environment for the institution, including a phase-in sequence
* Financial needs and possible sources
* User education and training
* Office Automation Support Staff

Definition of functional specifications

The institution must identify in detail the specific office automation functions it intends to implement. These functions could include word processing, document distribution, document archiving and retrieval, database maintenance, electronic mail, automated meeting scheduling, teleconferencing, automated project management, financial modelling, statistical and data analysis, voice response systems, voice message systems, optical character readers, and sophisticated database querying systems.

Equally important is the specification of access points and the procedural role of office automation. Clearly there is a trade-off between user access, convenience, and control and cost. The more distributed the access

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(i.e., the more work stations installed), the more expensive the ultimate will be system. At some locations or for some office environments, it may be desirable to have highly distributed access, while in other situations procedures may support a more centralized access point.

It should be noted, however, that effective office automation is not only powerful, but convenient. Microcomputers have allowed data processing activities to become distributed--that is, more under the control of the end user. Thus, financial modelling, report generation and preparation, and electronic mail lead to more creative management only if they are readily accessible to the individual managers and their assistants.

In addition to the specific functionalities and access of the office automation system, the institution must also clearly define the procedural role of office automation, both within specific offices and for interdepartmental communications. Analysis of current communications processes and flowpaths is crucial, and will often lead to surprising conclusions as to how the institution is now operating. Formal communications routes, identified in official procedures, may not correspond to the actual communications paths in place.

Definition of communications specifications

Much of the effectiveness of office automation derives from the communications capabilities it includes. Document distribution, electronic mail, and other information sharing promote effective coordination among various departments.

There are many communications configurations possible, ranging from communications via physical media (hand-carrying diskettes from one system to another) to fully interactive access from any given workstation to any given system. As with everything else, the comprehensiveness and the sophistication of the communications interfaces among the individual component systems is closely related to cost. The issues here are both functional and technical. The more integrated the system -- the more convenient it is to execute diverse computing tasks from a single workstation and pass information from one application to another -- the more technically complex are the solutions.

Ideally, the institution should utilize a single communications network for administrative computing, academic computing, and office automation in order to take advantage of the economies of scale. Functionally, there will normally be need to integrate office automation systems with administrative computing. Often, however, academic computing may be separated for political reasons, to ensure security of administrative systems, or simply because the needs of academic computing can be better served by a separate network.

The Implementation Plan must confront firmly the question of communications requirements for three reasons:

- To insure that all technical problems are identified and resolved in a timely manner

- To ensure that acquisitions are compatible with the ultimate communications environment
- To prevent the local development of communications which may prove incompatible or redundant
- To identify the costs and possible funding sources for developing and implementing the communications network

Definition of functional relationship between office automation and administrative systems

The philosophy of an integrated office automation network is one of distributed access to computing, and this may include the administrative databases. Fully integrated office automation may permit individual users to "extract" data from the databases in accordance with their individual needs, and "download" that data to their individual workstations for analysis. This data then becomes available for incorporation into documents, models, or for statistical analysis. Such access should promote more creative thinking by managers and better decision-making.

As managers and executives become more knowledgable about the capabilities of automated systems to present accurate data, they are seeking increasingly flexible access to that data. Most administrative systems were originally conceived and developed to support some administrative process -- payroll, registration, class scheduling, etc. Users are now seeking more creative ways of organizing the data to answer policy questions and to permit analysis of the consequences of alternative policies. New software, such as **Intellect**, marketed by IBM and developed by Artificial Intelligence Corporation, and **Mapper**, marketed by Sperry Corporation, permit creative manipulation of data by users. These systems, however, require extra resources, and any office automation implementation plan must consider the role of these "query languages" within the institution.

There are dangers in providing this type of convenient access to the central databases, however. Extracted data may be retained for later use, and thus become out-of-date without the individual user realizing it. The programs to extract the data must run on the central processor, and may become a substantial drain on the computing potential of the central processor. And easy access from office automation workstations may compromise the security of the database information.

Selection and/or development of appropriate hardware and software systems

Once the policy and procedure decisions outlined above have been made, the planning process must next turn to the specific hardware and software requirements.

The ultimate office automation network should be the result of an evolution from current activities rather than the total introduction of new equipment and systems. The selection of future systems must consider compatibility with current equipment. Further, the system implementation has to be phased-in, and the systems chosen must be amenable to such an approach.

Clearly an inventory of current equipment must be an early part of the Implementation Plan. Most likely, some of the current equipment will prove unsuited for an integrated environment. Functionally as well as technically, many current systems are obsolete and should be discarded. Be careful not to let current, inappropriate systems, dictate the final office automation configuration.

The office automation equipment selected should support well-established and powerful office automation systems. The issue is not one of developing such systems so much as selecting. Beyond the off-the-shelf systems available, however, there are potential software and hardware development projects involving:

- System interface with central databases
- The development of communications linkages between the mainframe computer and the office automation equipment
- Special user applications
    - Data entry and retrieval
    - File management
    - Major modelling projects
    - Utilities supported on the mainframe, such as electronic mail or text processing packages
    - "Query-language" access to administrative system databases

It is important that any plan developed for acquiring office automation equipment pay particular attention to the institution's administrative computing environment. The selected office automation systems must be able to fully integrate with the mainframe computer -- this includes both the technical aspects of communications and data transfer as well as the functional integration of the office automation activities with administrative data processing.

Definition of the network configuration for a mature office automation network

The institution must determine with a fair degree of precision the exact locations of workstations and the communications interfaces required for a complete office automation network. The distribution of workstations, and their exact locations, must be identified so that as acquisitions proceed, the new equipment is located correctly. If two or three departments are to share a word processing system, for instance, this should be identified prior to the acquisition of the equipment in order to ensure that the system is adequate for its intended later application and that it is correctly installed.

The most efficient way to develop a sophisticated office automation environment is to prepare the plan for the ultimate system, in which all workstations are identified and where the physical location of each component is designated. Knowing what the ultimate configuration is to be, then, permits the institution to identify a series of phases in which only certain components and functionalities are in place. These phases can then be in turn tied to annual budget allocations. This also permits flexibility should the institution determine to expand, reduce, or otherwise modify the Implementation Plan.

Financial needs and possible sources

The cost for the implementation of a complete office automation network is high. In a fully mature office automation environment, workstations would be as common as typewriters are today. Because of the high costs involved, it is imperative that the institution develop a clear picture of the final system so as to ensure efficiency of implementation, effectiveness of the final system, and appropriate funding is made available in a timely manner.

Typically, the acquisition of word processors and microcomputers in most institutions is funded by drawing funds from departmental budgets. This is an effective method, but does not encourage coordination with positive leadership from the top. An effective mechanism for providing institutional leadership is the use of "seed funds". Pilot projects, projects involving interoffice communication, or projects with high user commitment but insufficient funding should be funded out of the institution's general fund.

A crucial ingredient in the Implementation Plan is the creation of a budget for the implementation of office automation, and the identification of which items will be funded, or partially funded, out of general institutional funds and which items are to be funded out of individual departmental budgets.

User education and training

Whenever a new technology is introduced into an organization, there is the need for substantial user education. Many managers and directors who will profit in the end from the introduction of office automation will not understand initially what it does or how it will affect the operation of their offices. Administrative assistants and clerical personnel, who will be intimately involved with the operation of the system, need to be gradually introduced to the concepts of the system. Fears regarding technology and job security need to be addressed so that when the equipment arrives, the potential users greet it with enthusiasm. Even well designed and strongly funded systems fail when greeted with user apathy and hostility.

Immediately following the decision to proceed with an Implementation Plan, a training program must be begun to introduce users to the concepts of office automation. It should begin with director and manager level personnel, who must be shown that the system will improve their effectiveness without threatening their procedures.

Initial office automation projects, especially those already installed, should be identified as "pilot projects" and potential users should visit these projects and learn what is already happening within the institution. As more sophisticated office automation systems are introduced, and communications links established, these pilot projects will become a major educational tool.

The Implementation Plan must also include specific programs for training users in the actual operation of the office automation components as they are installed. It is likely that much of the detailed training can be offered in conjunction with the specific vendors, but the institution must also provide training in the unique features of offuce automation as implemented within the institution, especially as it involves the central databases and/or the institution's mainframe computer.

Office Automation Support Staff

The last issue to be addressed in the Implementation Plan concerns the personnel resources necessary to provide on-going support to the institution's office automation systems, both during the implementation phases and after it is fully installed.

There must be personnel to:

- Install, move, modify, and maintain equipment
- Provide coordinated liaison between users and vendors
- Provide technical support for the communications network
- Review requests for adding or modifying existing components
- Provide an education program
    - Seminars and group sessions
    - Individual user consultation
    - User documentation

The Implementation Plan must not only assess the total personnel resources needed both during planning and afterwards, but it must indicate when these personnel need to be identified and, if they are to be personnel in addition to current staff, what costs are associated with them.

Developing and implementing the Office Automation Implementation Plan

Clearly, any plan must include a detailed time-table. Developing this time-table, and implementing the Implementation Plan itself, requires a positive commitment from the highest levels of the institution as well as good project management. By adopting a coordinated evolution strategy, an institution of higher education will be able to develop the broad-based support and flexibility necessary to ensure success.

CURRENT ISSUES FORUM

MICROS ON CAMPUS: POLICY ISSUES

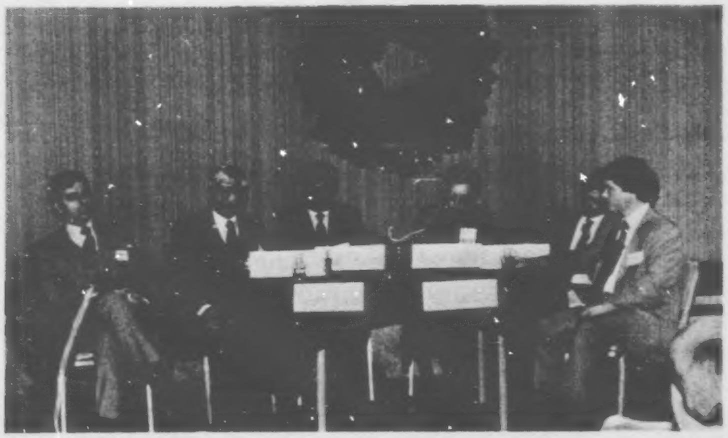
Panel Moderator Kate Doty

WEDNESDAY CLOSING SESSION

The Conference closed with a forum on one of the most pressing concerns in higher education today—the impact of the microcomputer on campuses nationwide and the consequent need to establish institutional policies concerning their acquisition, support, management, and security.

Panel members George Bosela, Phillip Nicely, Vinod Chachra, Kate Doty, Richard Nelson and Ray Scott discussed a number of issues including the advantages of centralized acquisition of microcomputers, campus bookstores and the microcomputer, support of the microcomputer, the role of the centralized data processing facility with regard to micros, coordination of the micros and the mainframe environment, and what policies need to be created to protect the security of the data. The format allowed substantial audience participation, interaction, and discussion.

Some panel members agreed to share their institutions' policies on microcomputers. Included in this section are the microcomputer policies contributed by Richard Nelson, Clemson University; Phillip Nicely, Miami-Dade Community College; George M. Bosela, Oberlin College; and Vinod Chachra, Virginia Tech.



Panel members, seated from left to right: George M. Bosela, Oberlin College; Phillip Nicely, Miami-Dade Community College; Vinod Chachra, Virginia Tech; Kathlyn E. Doty, Loyola University of Chicago; Richard Nelson, Clemson University; and Ray Scott, Carnegie-Mellon University.

PURCHASING COMPUTER HARDWARE AND SOFTWARE

The Computer Center provides advice and assistance on the acquisition of computer hardware and software. Use of this service is recommended in all cases, and is *required* in the case of equipment or software to be used in conjunction with the main computer.

Before any hardware or software can be acquired, whether on purchase or lease, approval must be obtained from the State Budget and Control Board, Computer Systems Division.

Obtaining Approval

The Computer Center will take the responsibility for securing necessary approvals from the State Budget and Control Board. Anyone wishing to acquire equipment or software must first complete a purchase requisition (CUBO 203) and forward the original to the purchasing office, together with a note indicating that the Computer Center has taken the responsibility of obtaining approval from the State Budget and Control Board. A copy of the CUBO 203 should also be forwarded to the Computer Center along with a memorandum containing the following information:

(1) Requestor's name and telephone number.

(2) A description of the equipment or software.

(3) Location at which the equipment is to be installed. Small items, such as modems and terminals, should be shipped to the Computer Center, where they can be checked out before they are installed.

(4) A justification for purchasing the item.

(5) Planned date of installation.

The State Budget and Control Board requires the following questions to be addressed in any request for approval:

(1) *Why is the item needed?* What function is to be performed by the requested item, how is that function being performed presently, and why is the present method no longer satisfactory?

(2) *Have alternatives been explored?* Could the function to be performed be accomplished by using (e.g. sharing) existing equipment? Are there less costly ways to accomplish the task? What would be the impact if the equipment were not acquired?

(3) *How many people will have access to the equipment?* When installed, how many people of what type (e.g. students, faculty, managers, or programmers) will make use of the equipment?

(4) *How often will the item be used?* With what regularity will the item be used? How many times per day, week, or month will it be used?

(5) *If more than one item of the same type is being requested, why is this number of items necessary?* Could fewer items be used and shared among the requestors?

(6) *Will there be a cost savings?* If the use of the requested itmes will result in a cost savings to the State, please specify when and how much savings will come about. If no cost savings are expected to accrue, please state this also.

(7) *If installation time is critical to the request, please explain why.* Why is it essential that the item be installed at the specific time?

(8) *From where will the funding for the requested item come?*

(9) *Will other items related to this procurement be requested later?* Is the requested item expected to grow in capacity? If so, to what extent? Is this procurement part of a larger plan or is this a stand-alone request?

The Computer Center will prepare a Request for Proposal (RFP) and submit it to the State Budget and Control Board. When the RFP is approved a copy of the letter of approval and the RFP will be sent to the purchasing office and the ordering department. The purchasing office will then issue the purchase order to the approved vendor.

The installation of new teleprocessing equipment (other than dial-up terminals) requires a dedicated communications port. If the user determines that such service is necessary or that changes are to be made to existing equipment, a "Teleprocessing Request" must be completed, then submitted to the Engineering Support Manager and approved by the Director. Those requests which are not approved will be returned along with a written reason for disapproval.

Computer Center staff are available to help in the determination of user needs and will assist in the preparation of the purchase requisition if requested. Academic Computing Support staff will put you in contact with someone who can provide the necessary assistance.

Sole Source Procurements

All equipment must be bid unless specific approval for a sole source procurement is given by the State Budget and Control Board. If you wish to "sole source" the equipment you must include a justification in your memorandum to the Computer Center.

Payment

The Computer Center will *not* acquire equipment using its own funds and then bill back to the departments via an inter-departmental transfer of funds. Departments must supply an account number to which the equipment can be charged directly.

Terminal Hookup Policy

Most users do not realize that it costs the Computer Center money to hook up a terminal to the computer, even if the terminal, modems, and the communications line are paid for by another department. Requests for the hook-up of department-owned terminals have reached such a volume that the University is taking steps to ensure that the departments bear the full cost of acquiring and connecting their terminals to the computer.

Remote terminals communicate with the computer via a communications controller, which handles the complexities of telecommunications line control, and it is in the communications controller that the extra cost of attaching additional terminals can be seen. Each line enters the controller via a port, and ports can be acquired individually up to the capacity of the controller. The situation is complicated by the fact that the controller is really itself a computer with limited memory and processing capabilities, and a small number of high-speed lines can exhaust its capabilities as easily as a large number of low-speed lines.

Periodically the Computer Center needs to upgrade its controllers (it has three) to permit the addition of more terminals. To finance these upgrades the University will levy a fee, in the form of a budget reduction, of $1,000 for each new line a department adds to the controller. This does not necessarily translate into a charge of $1,000 per terminal, and those departments acquiring clusters of terminals will, by judicious terminal selection, be able to minimize the charge. Each asynchronous terminal requires its own line and will result in an additional cost to the department of $1,000. Synchronous terminals (IBM 3270, Telex, Courier) require one line per terminal controller, but can avoid additional lines altogether if they can be multidropped off an existing synchronous line without significantly degrading the response of the terminals already on that line.

Many micro computers and word processors are being sold with software to emulate standard terminals, printer and/or card readers. Since these are not full time terminals, there are restrictions on how they will be allowed to connect to the system. Before making plans to acquire any terminals, please consult with the Computer Center staff to determine the most cost-effective terminal types to suit your needs.

Modems Policy

The Computer Center will make available a set of modems to requestors for a one-time use charge of $1,000. The modems will remain the property of the Computer Center and will be maintained by the Center at no additional cost to the user.

Gandalf modem owners can receive the same service by transferring their modems to the Computer Center inventory.

Forms and Magnetic Tapes

Printer forms and magnetic tapes are purchased under a state contract. Further information can be obtained from the purchasing office.

Summary

The steps required for obtaining computer equipment are listed in 1-8 below. On a "sole source" procurement omit steps 4 and 5. It is assumed that all preliminary investigation and development of requirements has been completed.

	Step	*#Working Days Required*
(1)	Submit purchase requisition and memorandum (done by requesting department).	-
(2)	Prepare RFP (done by Computer Center).	**10**
(3)	Release RFP (done by Budget and Control Board.	**10**
(4)	Await bids from vendors.	**15-30**
(5)	Evaluate vendor proposals.	**2-5**
(6)	Obtain approval to award bid.	**5-10**
(7)	Prepare purchase order (done by purchasing office).	**2-5**
(8)	Purchase order received by vendor. Delivery is usually 60 - 120 days.	**10-15**

Procurement of Computer Software

The number of requests by departments, colleges and staff members within the University to the Computer Center for the procurement of software packages has continued to escalate in recent years. In the past, the Computer Center has been able to honor most requests. With the increased number of requests, however, the Computer Center is faced with problems relative to the availability of funds to purchase and/or rent software and with a limitation as to the number of software packages that can be kept operable.

In November of 1979, the Computer Center staff presented their concern to the Computer Advisory Committee. As a result, the Software Acquisition Subcommittee was created and charged with studying the software problem and recommending guidelines for purchasing software to the full committee. The subcommittee presented its findings to the full committee at its regular meeting in March of 1980. The report was adopted and is presented as follows.

(1) Any department, college or staff member within the University wishing to request the addition of a software package to the Computer Center's collection for the academic year, should submit a written request to the Computer Advisory Committee by February 1 of the previous academic year. This request should be accompanied by a support package consisting of the following.

   (a) Specifications for program output, input, and computational algorithms.

   (b) Support expected from Computer Center.

   (c) Anticipated use of software (research, teaching, administrative).

   (d) Name and department of requestor, and approval of department head.

   (e) Justification for software to be reviewed by Computer Advisory Committee.

   (f) List of departments supporting software request.

   (g) Names of three vendors, if known, able to supply the software, and anticipated costs.

(2) All software to be charged to the Computer Center budget or requiring extensive support by the Computer Center must be approved by the Computer Advisory Committee. In the case of software requests exceeding the available budget, the Computer Advisory Committee will determine relative priorities.

(3) All software purchases must be approved in writing by the State Budget and Control Board Division of Computer Systems Management. "Sole source" procurement may not be specified.

(4) Requests for software packages not made by the February 1 deadline may still be considered by the Advisory Committee. These requests may be honored only if they are assigned a high-priority status by the Advisory Committee and if funds are available.

(5) The Advisory Committee will continually monitor the utilization record of all software packages. Packages which are not being utilized or which have a poor utilization record may be deleted from the Computer Center's holdings in order to release funds for the purchase and/or rental of packages which have a higher-priority rating.

(6) All requests should be directed to the Manager of Academic Computing Support.

Installation of New Software

Computer Center staff will gladly assist user departments in the installation of programs that they obtain themselves. However, due to the increase in the number of new programs, such installations must be scheduled to fit in with other Computer Center projects.

Academic Computing Support is compiling a list of user-supplied programs, that is, programs which have been developed or acquired by individual users or departments but which are of potential use to others. This list also contains names of users knowledgeable in the use of each program.

Engineering Support

The Computer Center has a staff of four full-time persons responsible for the maintenance of various items of Center-owned equipment and for the maintenance of the Clemson terminal network. The increasing burden placed on our Engineering Support staff by this large array of equipment significantly reduces the amount of time they can spend servicing other equipment, especially that which is user-owned.

Individuals or departments wishing to obtain service for their equipment should be aware of the following:

- The Center cannot guarantee always to be able to quickly respond to user requests for service on equipment not owned by the Center.
- Center-owned equipment, which is available for use by the entire user community, has first claim on Center personnel.
- Persons acquiring computer hardware should consider some kind of mainteke to know if that hardware can be serviced by the Center should inquire at the Help Desk.
- The Center will not perform repairs or call a vendor maintenance service on behalf of a customer without specific approval from the customer.
- The cost of parts used from the Center's inventory to repair or install user-owned equipment will be billed to the user.

In many cases what appears to be a problem with a peripheral device may turn out not to be in the device itself, but in the communications line or in a device elsewhere in the network. When in doubt as to the nature of the problem, users should call the Help Desk. An Engineering Support staff member will be contacted and he will attempt to make a determination of where the problem lies. The customer will be informed of the diagnosis, and if the problem appears to be in the terminal the customer can decide upon what action to take.

Contract Programming

The Computer Center does not, at present, offer programming services. However, Academic Computing Support maintains a list of programmers willing to do part-time programming. This list will be available strictly as a referral service and the Computer Center assumes no responsibility for the work done by these individuals. Those wishing to program, and staff members with jobs to offer, should contact Academic Computing Support at the Computer Center.

Contract programming is available from the Division of Information Systems Development (DISD) located in the E section of Martin Hall.

MIAMI-DADE COMMUNITY COLLEGE

MANUAL OF PROCEDURES

TITLE	NUMBER	PAGE
PURCHASE OF MICROCOMPUTER PROGRAMS AND EQUIPMENT TO SUPPORT INSTRUCTIONAL AND ADMINISTRATIVE PROGRAMS	7011	1 of 3
BASED ON POLICY NUMBER AND TITLE	**DATE**	
VI-1: PURCHASING	January 21, 1983	

I. PURPOSE:

To provide administrative steps to be taken in requesting the purchase of microcomputer programs and equipment for the support of the instructional and administrative programs.

A microcomputer is defined as a stand-alone computing device with provision for in-putting data and out-putting results of stored and programmed calculations. Complete systems, including peripherals and initial systems software must not exceed $10,000. Systems valued at under $1,000 are exempt from steps A, B, C, and D of this procedure, except where the campus Vice President determines otherwise.

II. PROCEDURE:

A. The originator will identify the functional requirements and justification and will submit the proposal to their campus' standing computer review committee. The committee will develop with the originator a purchase requisition, containing technical specifications for meeting the functional requirements. This requisition will cite the appropriate account number of the campus Audiovisual Services area.

B. In the case of campus functions having a counterpart at one or more other campuses, the originator will obtain verification in writing that the subject purchase requisition has been reviewed by the other campus counterparts. A copy of the written comments by the counterparts will be attached to the requisition for final review by the campus standing computer review committee which will address the issues identified by this review process.

If the review process indicates a need for combining requisitions or revising specifications, the standing campus computer review committee will be responsible for developing, along with the originator, the revised purchase requisition.

C. In the case of District Administration where requests for the purchase of microcomputer programs or equipment may have application for use by a campus area, the originator will obtain verification in writing that the subject purchase requisition has been reviewed by the appropriate potential user. A copy of the written comments by the potential user will be attached to the requisition for final review by the appropriate District standing computer review committee which will address the issues identified by this review process.

If the review process indicates a need for combining requisitions or revising specifications, the appropriate District standing computer review committee will be responsible for developing, with the originator, the revised purchase requisition

MIAMI-DADE COMMUNITY COLLEGE

MANUAL OF PROCEDURES

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D. Notwithstanding the steps above, the Vice President or his/her designee will verify in writing that the purchase requisition and the attached counterpart comments have been reviewed for true need, and that there are no practical substitutes now or on order to perform the functions for which the procurement is intended.

E. All microcomputer equipment will be placed on the inventory of the appropriate campus Audiovisual Services area, which will be responsible for inventory control, equipment custody, and coordinating the maintenance.

F. All requisitions for the purchase of microcomputer programs will be reviewed by the appropriate Audiovisual Services Director, who will be responsible for maintaining a microcomputer program library for the campus, for coordinating the interchange of programs, for group purchasing, and for avoiding duplication whenever possible. All microcomputer programs will be received by the appropriate campus Audiovisual Services area for inclusion in the College-wide union catalog of library material.

G. Upon receipt of equipment or computer programs, the Audiovisual Services area will notify the requesting office when it has been received and available for use. Where appropriate, the equipment or programs will be delivered for use at Audiovisual Services locations or will be assigned to the user on a custody basis.

H. These procedures will be in addition to all of the normal procurement procedures for appropriate dollar category and should be followed except as indicated under Section I.

	1-3-83
PRESIDENT	**DATE**

INTERIM PROCEDURE FOR THE REPAIR OF MICROCOMPUTERS

The acquisition of microcomputers for educational and administrative activities has recently become a frequent event at the College. Technological advances along with strong commercial competition continue to combine to make the purchase of these devices an even more desirable solution to many of our needs. If the College inventory of these devices continues to increase, and it is clear that this is likely to occur, a Collegewide procedure should be developed for their maintenance and replacement.

The College's experience with microcomputer repair has thus far been limited because of the newness of the devices presently on hand. Printer and disk drive problems have appeared to be the most frequent, but data on these repairs is limited and difficult to compile. A number of departments have purchased maintenance contracts, while others are paying by the hour for repairs. Still others have been fortunate to take advantage of warranty repair. No clear pattern has developed and the best approach is not yet apparent. It is clear that a study must be made of our present experiences and of the experiences of other institutions with similar activities so that the College may develop a long-range plan for the repair and replacement of these devices.

The following interim procedures are recommended:

1. A campus-wide inventory of all microcomputer and peripheral devices will be conducted by the campus Audiovisual Services Department. This inventory will list purchase dates and effective dates of maintenance contracts.

2. The campus Audiovisual Departments will be designated to coordinate the maintenance of microcomputers at each campus. These departments will keep a centralized record of each repair, including contracted repairs.

3. Repairs will be effected using a series of strategies:

    (a) An audiovisual engineer will be dispatched to determine if an in-house repair can and should be executed.

    (b) If outside repair is indicated, warranty repair will be attempted where feasible. Existing maintenance contracts will be used where they are in force.

    (c) When a paid repair is necessary, the Audiovisual Department will coordinate the repair with Campus Services in accordance with existing procedures for the repair of instructional equipment.

    (d) Loaner equipment will be secured whenever possible.

4. This interim procedure will become effective on January 3, 1983. The campus Audiovisual Departments will compile all repair data generated and develop recommendations for a long-range approach, including suggested funding resources, for the repair and replacement of these devices. This report will be received by the Collegewide Communications Technology Committee by September 1, 1983.

Micros on Campus: Policy Issues
Oberlin's Experience

I. Acquisition

The Oberlin program, since the Summer of '82, has been to provide a "mainstream" alternative for the acquisition of personal computers. That alternative was derived through the process of attempting to identify the most important concerns, and potential inhibitions, of the majority of students, faculty, and staff with regard to their acceptance of personal computers. The goals of our program are to encourage the purchase of personal computers by all members of the campus community based on each individual's realization of the contribution to personal productivity that such equipment can make.

The Computing Center became a "dealer", offering a transportable microcomputer with bundled software for sale to the college community at a price slightly above dealer cost. The Center also offered for sale a line of matrix printers, monitors, cables, modems, and other necessary hardware. In addition to providing the above equipment, the Computing Center has undertaken its maintenance at prices substantially below those charged by retail computer stores. The appeal of truly personal, transportable, low-cost, on-campus supported microcomputers with bundled software (most importantly a powerful word processing package) was determined to be the correct formula for most people's needs.

II. Support

Pursuit of the above primary objective has incorporated a number of important supporting activities and strategies. It is important to note that the

Computing Center's program was complemented by a presidential grant program providing partial grants to the faculty and staff of the College for personal computing equipment. While that program preceded our microcomputer support activities, there was enough overlap that most of those receiving grants were able to maximize the purchasing power of their grant by purchasing the equipment that we were offering.

A second supporting strategy was to provide as much institutional peripheral equipment as practical in order to further reduce the amount of money students were required to spend initially. Print stations, to which owners of our equipment could take a file on floppy-disk to be printed on either fast dot-matrix or letter-quality equipment were established, low cost drum plotters were made available, and a publicly available microcomputer cluster was created. The latter action was intended to serve two purposes, to permit prospective purchasers of our personal computer to determine firsthand the package's potential and to allow them to learn what would be involved in making effective use of it. Additional services included providing microcomputers linked to mainframe equipment in order to facilitate information transfer for those who needed that capability only infrequently. All of these actions, and others currently under consideration, are intended to create the most hospitable environment possible for the microcomputer user.

I feel that a critical factor in the success of our program has been our early realization that user interaction and self-help was an essential element of the environment that we were trying to create. An active and pragmatic users' group can, and should, provide a breadth of support services that an institution could not even consider for lack of staff and financial resources. Secondary and tertiary support structures, formal user group activities and informal interactions which result, are essential to the transformation of a department based program to a community based process. The user group that we unofficially initiated and cultivated provided a sense of comradery that has been very important to those consciously or unconsciously seeking positive reinforcement for their commitment to significant changes in their methods of productivity. The same could be said for those close to making a similar commitment, but still accumulating justification. The user group, meeting twice a month, has provided a forum for the sharing of experiences and the resolution of individual problems. It has provided training in the use of the software provided with the system. Through affiliation with a national users group, it has made available a large library of public domain software. Most importantly it gave visibility to an expanding critical mass of people on the campus with heightened productive capabilities thereby facilitating the process of convincing others that they should follow the same path.

Commencing this academic year the Computing Center has offered a number of "short courses" that deal with the microcomputer we are selling and the word processing program that comes with it. It is noteworthy that these seminars have been by far the most popular ones that we offer. We have also formalized a deferred payment program for students this year which requires a substantial initial payment and allows up to a year to settle the debt.

III. Micro/Mainframe Interface

Oberlin provides ten dial-in ports to support users who have access to microcomputers or terminals with telecommunications capabilities. We have made available to those purchasing micros from us a vendor supplied package consisting of a modem and the software required to communicate with other computers. A significant number of microcomputer owners have acquired the package and use their computer as a terminal to our central systems. We have provided an on-line bulletin-board for microcomputer information in our computer mail system and a on-line library of technical information on equipment, software, and general information.

IV. Security

We have not taken any special measures regarding security.

V. General

I believe that the most important step in dealing with the issue of microcomputers on campus is the first one. The decision must be reached that they are an important institutional concern, one that requires the identification of institutional goals and development of institutional policies. I have concluded that microcomputers are central to our mission as a liberal arts institution. While the potential application of such equipment justifies careful consideration by academicians in all disciplines, perhaps the strongest general case that can be made for incorporating personal computers in an institutional rethinking of higher educational processes is the impact that they have on the basic process of expressing thought in writing and on the quality of communications. Word processing can be the catalyst for many of the processes that have been traditionally thought of as liberal education. If, as I believe, quality of thought is mirrored in the quality of one written expression, the power and precision that word processing provides the scholar facilitates the refinement of writing and thinking skills. Interpreted in this fashion, personal computing can be viewed to be central to the objectives of liberal education.

While we have experienced all the problems that can be imagined in starting up such an ambitious program, probably our most serious mistake was in under-estimating the demands that it would place on our staff and the implications for maintaining the quality of our traditional services. If I were beginning again I would make a much stronger case for additional staff to support the program. At the on-set, while the dedication of our staff has contributed to what I feel has been a successful first eighteen months, it has not been without its cost in staff frustration and compromise in other areas.

MICROCOMPUTERS AT VIRGINIA TECH

POLICY, PROCEDURES AND PRACTICES

by

Dr. Vinod Chachra
Vice President for Computing
and Information Systems
Virginia Tech University

1. NEED.

Microcomputers, like minis and mainframes, are likely to be used for instruction, research, and administrative purposes. The numbers acquired for research and administrative purposes are certain to be far fewer than those acquired for instructional purposes. Several reasons have been cited for the acquisition of microcomputers: ease of use, low cost, full control, independence from external load or influence, and user convenience. However, the most urgent reason for acquiring microcomputers comes from the potential they offer in changing the device to port ratio. At present, Virginia Tech has some 2100 devices (terminals/micros, etc.). Networking techniques and port contending machines permit the number of computer ports to be somewhat lower than the number of devices. In the case of terminals, each port can easily support two or three terminals. Thus, the terminal to port ratio varies between two and three for acceptable levels of service. It is projected that the number of devices on campus will near 4000 next year and likely be at 6000 by 1986. Under present terminal to port ratios this would require in excess of 2000 computer ports. Two thousand computer ports and the necessary communication and computer capacity to support it will be prohibitively expensive. Hence, as the number of devices increase, the port to terminal ratio needs to be altered. The desired results can be achieved by using microcomputers that are networked to the mainframe. We hope that through the use of microcomputers the ratio of ports to devices can approach 1:10. The deployment of large numbers of micros is likely to change the nature of work done on the mainframes. We anticipate that the overall workload on the mainframe will increase not decrease. However, the work done on the mainframe will be substantially different.

2. OTHER MACHINES

2.1 Mainframes

With the growing use of mini and micro systems it is necessary to identify the application areas where one system is clearly superior to the others. This section tries to identify these application areas. As a general rule large shared computers will be used for the following four purposes.

1. Number crunching.
2. Data requirements.
   a. Large amounts of data.
   b. Small amounts but shared with large groups.
   c. Data archiving.
3. Special software.
4. Special devices.

2.2 Minicomputers

Use of minicomputers will be governed by their impact on personnel costs. As a general rule, minicomputers will be used under the following situations:

1. Minicomputers will be used in sponsored research projects where the sponsor so designates.

2. Minicomputers will be used in environments where the software requirement is very limited (like seismic data analysis), where the clientele is very restricted (like spatial data analysis lab) and where the machine can run essentially unattended. The objective is to reduce the personnel and software costs associated with the installation.

3. Minicomputers will be acquired and supported through departmental budgets. Departments must provide a personnel impact statement prior to the acquisition of minicomputers.

3. SOFTWARE

The technical and managerial issues associated with microcomputers are important issues. However, in large organizations like Virginia Tech, the most important issue is acquisition and management of software. Assume that the campus population of faculty, staff, and students collectively buy 2000 microcomputers. (Clearly this number is too small for Virginia Tech.) Assume further, that the systems require some package like Fortran or Lotus 1-2-3. The package can cost anywhere from $300 to $500. Simple multiplication will show that one can invest between $600,000 and $1,000,000 in a simple package unless alternate strategies are sought and implemented.

At a cumulative price of around half a million dollars for a simple software package, it suddenly becomes very attractive to consider developing software for inhouse consumption. Clearly, the marketplace cannot tolerate a situation where large groups like Virginia Tech are compelled to consider developing their own software. Hence, one must conclude that the marketplace will insist that suppliers of software make attractive volume discount or educational discount arrangements. It will be the policy of the University to seek out attractive financial arrangements for the acquisition of software.

4. APPROVAL

4.1 Approval for Student Micros

Certain colleges and departments may require their students to buy a personal computer in support of the academic programs in which they are involved. The internal approval process for mandating that departmental students purchase their own machines is as follows:

1. A recommendation from the departmental curriculum committee justifying the need for the personal computers and stating how the machines will be used in the curriculum offered by the department is the required first step. The department's recommendation has to be approved by the College Dean.

2. The financial implications of this requirement need to be discussed with the Vice President for Finance and the academic implications with the Provost.

3. The President must approve the decision. He will probably seek the approval of the Board of Visitors as the decision impacts the cost of education at Virginia Tech.

4. An RFP must be prepared, reviewed and approved by the Vice President for Computing and Information Systems. If State funds are not used, approval from MASD in Richmond is not necessary. However, if State funds are used (for laboratory or faculty machines) additional approval from the State must be sought.

5. The RFP must be mailed out to an approved vendor list. Responses must be evaluated and a selection made following procurement procedures established for this purpose by MASD. The University has completed such a process for the College of Engineering and selected the IBM family of personal computers for use in the college curriculum. The negotiated contract with IBM permits the purchase of these machines by students from all programs at Virginia Tech. The negotiated discount is passed on directly to the students.

4.2 Approval for Departmental Microcomputers

1. Departmental microcomputers may be purchased either through the same contract that has been negotiated for the students or through one of the many contracts approved by the State.

2. The department may acquire the machine that best suits its program needs subject to the procurement policies of the State.

3. It is recommended that the machine acquired by the department be one that is supported by the University (see the section on support).

4.3 University Acquired Machines

1. It is a policy of the University to provide general purpose laboratories consisting of terminals and personal computers for use by students, faculty, and staff.

2. These laboratories will be installed and equipped by the Computing Center.

3. There will be no chargeback associated with the use of the personal computer laboratories as long as the laboratory is used in a standalone mode. The laboratories must be used only for purposes approved by the University.

4. Personal computers located in the laboratories will normally be connected to the campus data communications network. Connections to the mainframe and its use will be charged at normal rates for mainframe usage and will be governed by policies in place for mainframe use.

5. SUPPORT

It is the present policy of the University to provide local support for microcomputers on campus. The local support will consist on the following:

1. The Computing Center will coordinate the maintenance of the micro computers. The Computing Center will maintain a record of each machine and owner showing the equipment and the maintenance options in effect. This information will be used for producing statistics on the nature, use and reliability of microcomputers on campus.

2. The Computing Center will receive all computer shipments, unbox and test each machine for proper operation prior to delivery to the customer (faculty, staff, and students).

3. The Computing Center will establish procedures to provide warranty maintenance on the machines.

4. The Computing Center may subcontract with other departments on campus (like the Electrical Engineering Department) to provide hardware maintenance for the machines.

5. The Computing Center and user departments will jointly evaluate software offerings and determine a set of software that will form the software tool kit. Efforts will be made to negotiate institutional licenses for the software. Where institutional licenses are not possible, volume discounts will be negotiated.

6. The University will adhere strictly to all software laws pertaining to the acquisition and use of copy-righted software.

7. The Computing Center will attempt to acquire such software that best integrates with software already available on the mainframes and minicomputers on campus.

8. The Computing Center will provide adequate documentation for the software and hardware that is part of the microcomputer program.

9. The Computing Center will not be involved in the acquisition and distribution of supplies, like paper and diskettes. The supplies are best purchased from the University Bookstore.

10. The Computing Center will provide the needed training courses or acquire and make available training diskettes so as to appropriately train the user community.

11. The Computing Center will provide consulting services on a resource-available basis to faculty and graduate students to insure the proper and effective use of personal computers. Such consulting services will not be open to undergraduates who must contact their class instructors for help.

12. It will be the objective of the University to arrange for financing from time to time to permit faculty and students to buy personal computers on a time payment plan.

VENDOR PARTICIPATION

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Information Associates

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Cincom Systems, Inc.

Lynn Kosmakos
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PARTICIPATING COMPANIES

Participation of the following companies in the 1983 CAUSE National Conference was greatly appreciated:

American Management Systems, Inc. (AMS)

Cincom Systems, Inc.

Computer Technology Systems

Control Data Corporation (CDC)

Corvus Systems

Datatel Minicomputer Company/PR1ME Computer, Inc.

Deloitte Haskins & Sells

Digital Equipment Corporation (DEC)

Electronic Data Systems Corporation (EDS)

IBM Corporation

Information Associates, Inc. (IAI)

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PACKAGE OR CUSTOM FINANCIAL SYSTEM IMPLEMENTATION:

THE AMS APPROACH

There are a number of signs that may indicate, to a financial vice president or data processing director that their college or university's financial management information system is in need of replacement. The problems usually include these conditions:

- Lack of timely and accurate financial information
- No financial controls in system
- General Ledger, Purchasing/Accounts Payable Ledger and other subsidiary ledgers out of agreement
- Must enter data several times into several different systems
- Running out of account codes
- Sponsored programs disallowances
- Must close old month/year before starting new period
- Difficult to maintain and/or undocumented
- Unsupported language
- Batch system

If your financial management system is exhibiting many of these problem conditions, it is likely that you are considering its replacement.

If you have decided to replace your financial management system, you can either do it in house, having the data processing department build a new financial management information system, or you may seek help from the outside. This help from the outside could be in the form of a software package, a custom system, or a system acquired from another college or university through system exchange. The following are some of the pros and cons for each of these approaches.

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IN HOUSE DEVELOPMENT

PRO	CON
Meet Unique Needs	Re-invent the Wheel
Tailored to Technical Environment	Slower Implementation
Control Over Process	Staff Turnover
Utilize Existing Resources	Documentation
	Backlog

SYSTEM EXCHANGE

PRO	CON
Cost	Built for Someone Else
Sharing Ideas	Inflexible
	Documentation Inadequate
	Support Not Available
	No Enhancements

PACKAGE SOLUTION

PRO	CON
Cost	Inflexible
Fast Implementation	Reliability of Vendor
Future Enhancements	Lack of Key Features
Specialists	Hardware compatibility
Continuous Support	
Professional Documentation	
Users Group	

CUSTOM SYSTEM

PRO	CON
Meets all Needs	Higher Cost
Specialists	No Vendor Enhancements
Professional Documentation	No Users Group
Fast Implementation	
Future Support Available	

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As you can see, the approach which may be correct for one college or university may not be appropriate for another, because of a combination of such factors as cost, fit, features and functions, available staffing, and vendor support.

The AMS approach to financial management information systems for college and universities offers schools an opportunity to choose the outside assistance approach which best meets their specific needs. Based on extensive consulting experience and on hundreds of successful software implementations, AMS will recommend an implementation of the College and University Financial System (CUFS) package, the use of the CUFS package as a base for custom development, with certain features modified and certain subsystems added, or a full custom system design and development project. The package implementation and full custom system approach are both traditional paths to follow in acquiring a new financial management system. The middle approach, using CUFS as a basis for custom development, may be very appealing to schools who need to meet requirements imposed upon them by external agencies, or who need subsystems beyond those available with the CUFS package. Much of the economy of the package implementation may still be realized, while custom modifications enable the system to meet unique institutional needs in full.

CUFS is a fully integrated, on-line financial management information system which was specifically developed for colleges and universities. This system manages all financial activity for a school, including:

- Budgeting for Revenue and Expense
- General Ledger
- Purchasing
- Encumbrance Control
- Accounts Payable
- Accounts Receivable
- Automated Disbursements
- Grants Management
- Planning
- Reporting
- Security and Approvals

In addition to the basic CUFS system, a number of optional subsystems are available, which are fully integrated with the baseline package and which may also be added to the system at any time:

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- Extended Purchasing
- Fixed Assets
- Job Cost Accounting
- Investment Management
- Performance Measurement
- Cost Allocation
- Report Distribution

Reporting under CUFS is extensive. Over 170 standard reports are provided including transaction listings, account code listings, budget preparation reports, budget versus actual reports, accounting management reports, financial statements, open items listings, and the three NACUBO/AICPA standard financial statements - the Balance Sheet, the Statement of Changes in Fund Balances, and the Statement of Current Funds Revenues, Expenditures, and Other Changes.

AMS provides extensive consulting support with CUFS, to assist the institution with planning for the accounting aspects of the new financial management system, installation assistance, full user and technical training, and ongoing support, including a first year warranty, regular enhancements, a full maintenance program and an active user's group.

AMS was founded in 1970 and is one of the largest independent computer systems and services firms in the United States, with over 900 employees and 1983 revenues in excess of $85 million. AMS is headquartered in Arlington, Virginia and has regional offices in New York, Chicago, San Francisco, Denver, and Houston.

TIS - THE RELATIONAL CONCEPT MADE PRACTICAL

Tom McLean

Cincom Systems, Inc.

Cincom's TIS completes the data base management system concept. This may seem to be a rather bold statement, especially when one sees the developments appearing on the market such as IBM's SQL/DS and relational data base. In order to understand why TIS completes the DBMS concept, it is necessary to briefly review the evolution of data base.

In the 50's, when commercial data processing was first introduced, life was relatively simple. In most cases, an application program and the data required for that program were conceptually locked together. The data was, in effect, an extension of the program and the program dealt with the data as if it were the exclusive user of that information. For the sake of economy, the data was stored separately from the program, either on punch cards or tape. As programs became more complex, they began using multiple data files. The relationship between these multiple files, however, was hard coded and maintained within the program itself. This made the program more complicated and larger.

Another layer of complexity was added to data processing when multiple application programs began using the same data in different ways. This gave birth to the era of "SORT-MERGE-PROCESS." The SORT and MERGE steps were actually required to put the data into the format which the program required. In other words, a different view of the data files was prepared for each application program through the SORT-MERGE process.

This technique, however, created enormous problems. Multiple versions of the same files began to exist and updates to these files were in many cases not synchronized, creating multiple versions of the truth. If data processing operations analyzed the activity of the computer system, they would have found that most of the work being done was in fact unproductive. The same data files were being sorted in different ways which really accomplished nothing for the end-user. This phase probably represents one of the low points in data processing. If a new approach to data management wasn't created, data processing would have found itself in an endless, downward spiral of decreasing productivity.

The introduction of the data base management concept in the late 60's and early 70's solved many of the problems created by the "SORT-MERGE-PROCESS" method of data processing. The DBMS took on the role of defining and managing relationships between data files. This greatly reduced the complexity of the application programs. The DBMS also allowed multiple views for different programs of the same data. This eliminated the need for storing data redundantly which insured consistent information throughout the entire organization.

Another important benefit of the DBMS concept is that of data independence. This meant that the programs were independent of the format of the various records in the data files. Records could be expanded or modified without affecting existing application programs.

What the DBMS concept did not provide, however, is data structure independence. If data was moved from one file to another, the application program had to be modified. This was because programs still dealt with "Data Files" rather than the logical data needed for processing. Another technological breakthrough was required. This breakthrough would allow programs to deal with common data and have that data presented to them in the format which is most efficient for their individual processing needs. Using this concept, programs deal with logical data rather than with files.

Cincom's TIS, with the new Logical User View (LUV) facility provides exactly the technology necessary to bring the data base management system concept full cycle. LUV provides a relational view of data. This means that each program acts as if it had all the data it needs for processing in its own logical files.

The data is formatted into tuples (another way of thinking about this is transactions) and these tuples are passed to the program upon request. The data, in effect, becomes a logical extension of the program and the program deals with data and not files.

What benefits does this provide the end-user? All of the benefits of data base management systems, i.e., data independence, elimination of data redundancy, data structuring, multiple user views of the same data, are provided as well as the things which the DBMS technology did not provide, such as complete data structure independence. All data access and relationships between various physical data are handled by the TIS system. This makes applications programming extremely simple, with only four commands required to carry out any data operation (GET, WRITE, INSERT, DELETE).

Another major benefit of the TIS Logical User View system is that it provides complete isolation from change. By change we mean not only changing disk drive hardware or the CPU vendor, but the technological changes which we see forthcoming within the next five to seven years. The new technology will mark the decline of the use of disk drives as the main data storage media. Data will be stored directly in the computer and programs will be loaded to run against the data. The expanded 32-bit addressability in the IBM 3083 is the forerunner of this new data storage technology. Disk drives will go the way of tape drives. In order to take full advantage of this new technology, users will be forced to convert the way their programs access data - just as conversion was required to take full advantage of disk drives. The new TIS Logical User View facility isolates the user from changing technology. The programs are not accessing data files but rather logical data and it becomes irrelevant if this data is stored in disk drives or directly in main memory.

To this point we have been discussing the new data management technology of TIS. This technology, however, is merely the engine which drives the entire TIS system. TIS is the first system designed from the ground up to be fully integrated. This full integration is achieved through the use of the TIS Directory. The Directory stores all the information necessary for the Logical User View processor to be able to access the physical data. In addition, this common Directory, which is fully active during program processing, assures that all of the TIS components fit perfectly together.

Another of the major philosophies of TIS is to make the system completely accessible and usable by relatively unsophisticated end-users. The era of application programming, without application programmers, is upon us already. TIS provides a very high level, extremely user friendly, query facility which incorporates many of the concepts of artificial intelligence and makes the system accessible by even novice users. The same query facility can be used to produce batch reports, as well as providing on-line information.

The Comprehensive Retrieval facility of the TIS allows even the most complicated reports to be produced by unsophisticated programmers or end-users.

Cincom's on-line, high level application development system, MANTIS, can be used to develop complete, complex on-line applications in a fraction of the time required by normal programming techniques.

Cincom's TIS, the system which completes the DBMS concept, is the only system which allows application programs to deal with data rather than files. It provides a relational view of physical data, a new level of isolation from changing technology, and it is the only modern system designed from the ground up to be fully integrated.

For Additional Information: Cincom Systems
2300 Montana Avenue
Cincinnati, Ohio 45231

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COMPUTER
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PROMATCH FOR CAUSE CONFERENCE PROCEEDINGS

Computer Technology Systems has recently introduced a technologically innovative and exciting software program for the college placement office called "ProMatch." ProMatch was developed in order to provide placement offices a comprehensive system for job interview matching compiled with word processing, mailing label functions, and to provide storage capabilities for other data relevant to the department. The ProMatch system is a highly functional, user-friendly management center for the career placement center. Although the system is extremely comprehensive relative to functional capability, the simplistic user format can be mastered in approximately two days.

The heart of the system involves entering resume data through a question and answer format stating the person's career objectives and historical data such as education, work experiences, along with other personal experiences and accomplishments. Students and alumni seeking a career or career change will be entered into the system to form a data bank of resumes. This data bank of individual resumes would be maintained and kept current through updating, deletion, etc.

Matching for interviews is accomplished by supplying the qualifications sought by the interviewing company through a question and answer format. The ProMatch system allows the operator to use as little as one or as many as twenty matching parameters (to match a company need, relative to job qualifications, to that of a student or alumni). The quality and quantity of matches can, therefore, be controlled depending on the degree of qualifications sought. The system is very flexible.

Matched resumes for interviews will appear by listing the student or alumni I.D. number. Any one, or all, of these matched resumes can then be viewed on the CRT and/or printed for hard copy. In some cases, the director of placement may want to post on the bulletin board only the matched resume I.D.'s so that these people can sign up for the interview. The director may also elect to give a hard copy of the matched resumes, or just partial information, to the interviewing company. The information can be used in many different ways depending on the desires of the department.

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Loveland, Colorado 80537
1-800-531-1749
663-1400 in Colorado

Student transcripts and recruiting company data files can also be stored and used with the system and can be accessed and updated at any time. Each file can be maintained, viewed, deleted, or printed (partially or completely). The word processor, or letter writing capability, can be used in conjunction with those files to retrieve names and addresses. Mailing labels for envelopes can also be printed automatically from these files. Different types of statistical data can also be retrieved from the system that might include the type of job found or the type of company interviewing etc., which would assist in career counseling and other department strategy. The amount of valuable information that can be extracted through the use of the ProMatch system, in addition to matching for job interviews, letter writing, and mailings, is extensive.

The complete stand alone ProMatch system is very powerful but physically small. The system including all software, along with hardware, can be placed on one-half of a desk top. A system can maintain as few as 300 or as many as 11,000 resumes. The price will vary depending on the storage size. Software without hardware is also available and operates on CP/M-86 or the IRIS operating systems.

Please contact Computer Technology Systems at 1531 N. Lincoln Avenue, Loveland, Colorado, 80537 (303)663-1400 or 1-800-531-1749 for more information about this product.

CONTROL DATA
555 University Avenue, Suite 150
Mailing Address/Box 13002P
Sacramento, California 95813

At CAUSE 1983, Control Data will exhibit some solutions to current higher educations needs. The following applications will be included:

- Student Aid Management (SAM)
- Remote Micro Facility (RMF)
- Information Processing Facility (IPF)
- Micro IPF
- On-line training for familiarization of staff through PLATO

SAM which is the first part of an integrated administrative system was developed by Sigma Systems and is offered by Control Data to run on the CYBER 170/700 or 170/800 series. SAM is a comprehensive package of programs that support the administration of student financial aid in colleges and universities. SAM provides automation for: Application Tracking, Student Need Analysis, Evaluation, Packaging, Notification, Disbursements, Fund Management, Analysis and Reporting, and Compliance Monitoring. By performing routine clerical functions, SAM enables aid administrators to spend time dealing with exceptional situations requiring professional judgement.

RMF is a Control Data product that allows you to transfer binary and text files between a microcomputer and the CYBER computer. You also use it to make your micro act as an interactive terminal. With RMF, you can take advantage of the convenience, interactive operation, and low cost of a microcomputer, as well as the large processing power and software base of the CYBER.

Control Data Corporation is proud to demonstrate IPF, which offers NOS interactive users a group of data management facilities which service the needs of end users. In addition to the mainframe version of IPF, there is the Micro IPF for individual users who need a powerful data management program to run on a micro, such as the Control Data 110 or on an IBM PC.

One of the nice things of this particular combination of systems is the link-up capability between the two. Micro IPF includes the same architectural features and performs the same basic functions as mainframe IPF. While mainframe IPF is for bigger, more complicated jobs, Micro IPF can take care of smaller, simpler problems. At the same time it allows freedom from being connected to a port and limits the need for expensive phone connections.

You do not have to be an experienced programmer to use or understand Micro IPF. Some of its special features include: simple data definition, user definable forms of data entry, and easy query of data files. In addition, it is able to generate reports for both printer and screen. Micro IPF offers access to on-line HELP screens.

If you want any more information on any of these applications, please feel free to contact your nearest Control Data office.

CORVUS SYSTEMS

At CAUSE 83, Corvus Systems featured the Corvus Concept personal workstation, and ISYS, a revolutionary and new integrated system of software uniquely designed for the Corvus Concept. This includes the most powerful word processor in the world today. The word processor has unique features and capabilities such as time-travel editing (unlimited undo/redo), and on-screen display of underlining, strike-out, superscript, subscript, and boldface, that are not available on even the most expensive dedicated word processing system.

Corvus specifically designed the word processor to take maximum advantage of the impressive power of the Motorola 68000 processor and full-page 8 1/2 x 11 inch Concept screen in the vertical or portrait position. In addition, the screen can be flipped to the horizontal or landscape position for use of the electronic spreadsheet. In this orientation of the Concept, the spreadsheet can present a full 13-column display, or a full year of forecasting data, without scrolling. Furthermore, the word processor and electronic spreadsheet are fully interactive with Corvus' business graphics software that offers virtually automatic creation of fully rotatable, three-dimensional graphics of numerical information. The ability for the user to construct a graph and view it as if from any angle in space allows four data dimensions to be correlated simultaneously.

Finally, ISYS includes the remaining integrated applications: data communications, list management, sorting, information lookup, a calendar, a calculator, a clock with international time zones, a stopwatch and interval timer, and all functions of the Corvus Concept Operating System (CCOS). ISYS lets users transfer data from application to application by the Inter-Process Communication (IPC) files. Unlike data produced by most independent applications, IPC files share their data with the word processor, spreadsheet, and other functions.

For Additional Information Contact:

CORVUS Systems
2029 O'Toole Avenue
San Jose, CA 95131
(408) 946-7700

CORVUS SYSTEMS

In addition to the Corvus Concept and ISYS, UNIPLEX, a compact Motorola 68000-based desktop processing unit, was featured at CAUSE 83. Its unique blend of features is designed to offer maximum flexibility and performance in the UNIX Operating System environment.

Ideally suited for applications requiring a low-cost, high-performance processing node, the Corvus UNIPLEX is capable of running the UNIX Operating System as well as performing as a network device. Typical uses include applications processors, file systems hosts, and intelligent gateways.

The system features an 8 MHz Motorola 68000 processor with 32-bit data and address registers, 24-bit memory addressing, and a 16-bit data bus. Memory management consists of a custom memory manager which supports 16 separate contexts. Each context can have up to 64 segments and each segment can have up to 63 2K byte pages.

The UNIPLEX I/O capability includes the powerful Corvus OMNINET Local Area Networking capability as an integral part of the I/O structure of the system. Additionally, the system has two standard serial I/O ports and four I/O bus slots for maximum system configurability. Available peripheral controllers for the I/O bus include local 5" and 8" Winchester disk drives, floppy disk drives, serial controller with six additional serial ports, and the like.

UNIX is a powerful multi-user, multi-tasking operating system, ideally suited for the supermicrocomputer environment. Originally developed for minicomputers at Bell Laboratories, and licensed through UniSoft Systems, the system boasts a rich set of system utilities and language processors for both text and data processing.

For Additional Information Contact:

CORVUS Systems
2029 O'Toole Avenue
San Jose, CA 95131
(408) 946-7700

COLLEAGUE - An Integrated Administrative Software System
for
Colleges and Universities.

COMPANY PROFILE

COLLEAGUE is a product of Datatel Minicomputer Company (DMC) of Alexandria, Virginia. DMC, organized in 1968, has installed over 300 minicomputer systems and has acquired over 500 customers throughout the United States. The company has grown to over 200 professionals who provide services to banks and distributors, as well as colleges an universities.

COLLEAGUE APPLICATION SOFTWARE

The College and University Administration Computer System (COLLEAGUE) was specifically designed and developed by DMC to meet the current and future needs of higher education institutions. Its development has over 50 man-years of effort behind it. After extensive testing DMC installed its first system in 1979 at Willamette University. Currently, COLLEAGUE is being used by many colleges and universities across the United States.

COLLEAGUE contains fifteen separate program modules each of which is a comprehensive application for a specific administrative area such as Admissions, Registrar, Financial Aid, Alumni/ Development, General Ledger, Purchasing, etc. Because each of COLLEAGUE's modules are fully integrated, once an information entry is made all users can simultaneously access the system. Although COLLEAGUE allows access of this data to all other areas and modules, security built into the system maintains the confidentiality of information contained in each module against unauthorized access.

The "base" COLLEAGUE package consists of ten (10) modules:

- Admissions
- Registrar
- Financial Aid
- Alumni/Development
- Personnel
- Purchasing
- Accounts Payable
- Accounts Receivable
- Cash Receipts
- General Ledger

The "optional" COLLEAGUE modules include the following:

- Payroll
- Student Affairs/Housing
- Fixed Assets
- Physical Plant Work Order

A Library Circulation module is currently under development and is near completion.

Unique to Colleges and Universities

Because no two schools are alike, COLLEAGUE is engineered for flexibility to meet requirements unique to each campus. COLLEAGUE was designed for use by Colleges and Universities only. The business of running a campus requires cost efficient actions and creative long-range planning. COLLEAGUE makes this critical job a controlled part of your day-to-day operation. COLLEAGUE will serve a school with a student body numbering less than a thousand or a large university. Both private and public schools across the United States presently enjoy the cost-effective improvements COLLEAGUE has brought to their campuses.

Greater Financial Awareness

COLLEAGUE incorporates the NACUBO principles to create true fund accounting abilities for your school. You maintain your present number structure to design a specific chart-of-accounts when you use COLLEAGUE. Encumbrances are figured by the system so that a true financial outlook can be obtained simply on command. The flexible financial processor allows you to design reports to fit your financial reporting and analysis needs.

Record Student Activity

COLLEAGUE's student records applications, including Admissions, Registrar, Alumni/Development, Financial Aid, and Student Affairs/Housing have been engineered so that each application is integrated. That means information is entered into the system once, and is available, with protections, to all appropriate offices. For example, a change in a student's record is immediately accountable in affected administrative offices. Advisors can react, financial aid can be re-evaluated or registration may be impacted. Student earnings under college work-study programs are also monitored.

For more information contact:

Datatel Minicomputer Company
3700 Mt. Vernon Avenue
Alexandria, Virginia 22305
(703) 549-4300

FUND RAISING IN THE 80's

In recent years, there have been drastic shifts in the traditional college-age population, coupled with significant reductions in the amount of governmental support available to educational institutions. These changes have forced many schools to re-emphasize fund raising as a means of maintaining the quality of programs, at the same time that they have been re-examining their educational programs and potential student populations. Even schools which had not traditionally looked to graduates as a source of funds are now struggling with the resulting data management requirements.

The basic information required is well known -- who are my prospects, and where do they live? Defining who constitutes a good prospect is affected by the nature of the particular campaign. However, the individual characteristics of specific donors are often not readily accessible, so the tendency exists to return continually to the same target population.

Also often overlooked is the need to strategically plan a particular campaign or appeal. Without a ready capability to test out assumptions concerning the potential yield from a particular approach, coupled with the ability to report the actual results of that effort, organizations are often unable to regroup when expectations are not met.

The desirability of computer support "sells" itself. What are the options available? Use of service bureaus has the advantage of a relatively low up-front cost, but as volume increases, it becomes costly, and limited flexibility and slow turnaround become critical issues. Use of campus computing resources is an option only if there is a firm commitment to providing continuing support for changing needs. As a result, stand-alone systems are gaining recognition as a resource which can be controlled by the end users, in accordance with their immediate needs.

The software can pose a problem, since the fund raising office rarely has the necessary skills to adequately define requirements, let alone program to meet them. While in-house development is always an option, implementation of a package is a faster, often more efficient, means of serving user needs. Conversely, this option is often perceived as a severe limitation on the flexibility available to the user.

Ease of use is another important issue. The ability to access required subsets of data-generating lists, labels, letters, or files for analysis is of major importance. The lack of this capability is a frequent failing of many "canned" systems. Furthermore, the ability to have "conditional" data available for use in predefined circumstances, is a feature which is rarely available in packages, yet is of substantial benefit in providing a truly personalized approach. Examples are, provision for an alternate mailing address, or, ensuring that certain types of mail are not sent to a particular prospect.

Similarly, the actual specification of what and how information is to be maintained is often severely limited by the design concept. A usual approach, in order to provide the required reporting capabilities, is the use of codes (user defined) which are frequently difficult to "translate" and change, at least for the non-data processing user. Defintion of the edits which are appropriate to maintaining the accuracy of the data being stored is another consideration. These may relate to user-defined values, or may be expected constants, such as recognized name prefixes or suffixes. Tables are built and maintained -- often requiring substantial technical support if changes are required.

Development tools and database management techniques now available for use on minicomputers make it possible to provide the required capabilities in an environment which is not so technical-staff dependent. Built-in routines for modifying tables, accessing values while doing data entry, and keying in on user-defined values to define subsets of data make it possible to effectively use the information which is, or can be, available. At the same time, upward migration to larger machines, with greater disc capacity, without having to modify any of the applications software, is now possible. Therefore there is considerably less risk associated with committing resources to the purchase of necessary hardware. In addition, the level of technical sophistication required to operate the current generation of minicomputers is clearly minimal relative to the old mainframe environment.

The ability to operate relatively independently is not without its problems. Successful integration of the stand-alone system data in the give and take with other university offices must be carefully considered. For example, the downloading of student-related information to add to the prospect base must recognize the possibility of duplication of records for any returning students previously captured. The need to report the financial results of a campaign, and possibily transmit the funds to centralized accounting offices, makes it critical to be able to record gifts by fund, department, campaign, or other breakdown. If the primary records are maintained in conjunction with the fund raising office, it is important that the system have an adequate audit trail, and sufficient reporting capabilities.

Some other items that are worth mentioning for inclusion in a flexibly accessible database are: a ticklerized pledge tracking system, matching gifts tracking, gift reporting and name cross-referencing capability, and a foundation database which permits referencing multiple individuals within an organization. In deciding what information to store, users must be reminded that the cost of extensive detail is the effort required to maintain the accuracy of the database.

One final item which is often overlooked is the need to maintain security relative to accessing the database. Password protected access to categories of data is necessary to ensure that unauthorized individuals cannot read or change sensitive data. "Target" files created to address specific subsets of the prospect base and specific planning models should also be protected, to preclude the possibility of another user changing a file without the knowledge of the "owner". These security considerations are, of course, more difficult to effectively address if the machine is accessible to a wide variety of users (particularly creative students).

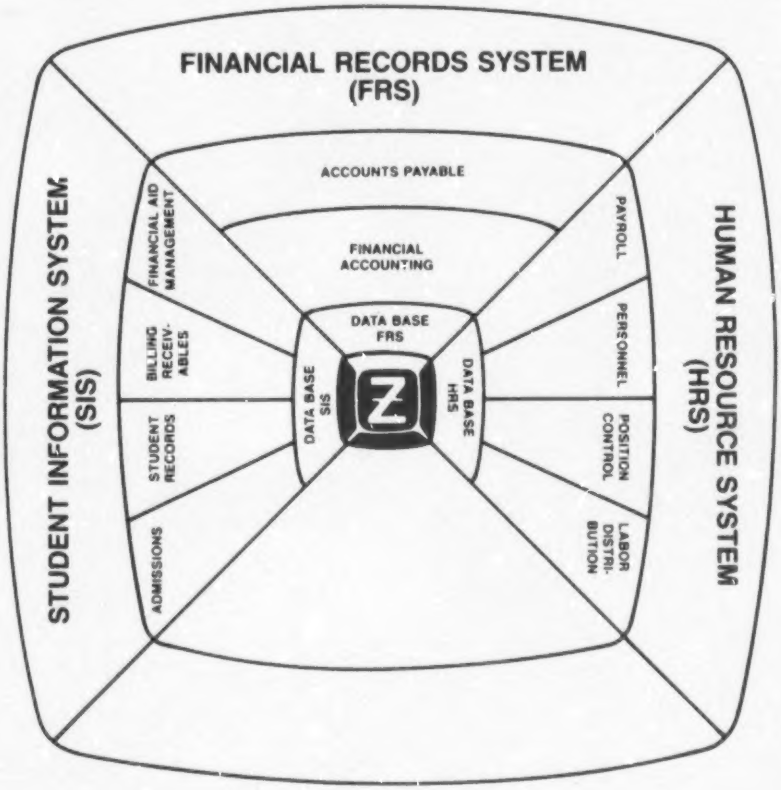
The list of important considerations could be expanded at length. These are some of the most visible ones which have been addressed in the design of the Wang-based FUND RAISER system. For additional information contact:

Sandra J. Manilla, Manager
Deloitte Haskins & Sells
One World Trade Center
New York, New York 10048
(212) 669-5436

Deloitte
Haskins+Sells

SERIES Ƶ: GENERAL CHARACTERISTICS AND FEATURES

A proven system for today's information management needs.



Series Ƶ is an integrated, on-line software system designed specifically to meet the information management needs of colleges and universities. Incorporating proven concepts from our years of experience with colleges and universities we've created an affordable system for today's mini and mainframe computers.

Series Ƶ is actually three application systems in one: Financial Records, Human Resource and Student Information. All three systems interact with each other. Most of all, however, Series Ƶ provides you with all the information you need to make timely, accurate, intelligent management decisions.

Series Ƶ incorporates an integrated system structure to efficiently handle separate categories of processing, yet address the entire administrative needs of the institution. The Series Ƶ design eliminates data redundancy and promotes efficient processing.

A modular approach to design and integration has been applied. Such design permits 1) phased implementation allowing systems to be added as necessary and within the priorities of the institution, 2) modular sequence flexibility, 3) elimination of data redundancy, 4) a consistent data definition to be maintained as well as system integrity and security, 5) insulation from computing environment changes, and 6) continued development of modules to meet the higher education administration computing needs.

Series Ƶ Data Handler

The Series Ƶ Data Handler controls the storage of data and defines how that data will be integrated. The Data Handler functions as a Data Base Manager for the Series Ƶ administrative programs, integrates with other Data Base Manager Systems or with other non Series Ƶ application programs. The Data Handler also controls screen formats, and procedures and enables the user to quickly make changes within the system, often without reprogramming.

Security

Series Ƶ has been designed to "police" your information and let you control who sees what. The various levels of security control include: system, application, function or data element or the institution can define special access for limited use. Series Ƶ also defines on-line changes according to security levels in the same fashion.

On-Line Data Entry, Inquiry and Update

Input to Series Ƶ goes through a single channel, regardless of date, quantity or sequence. This includes both initial data entry and update of those data. All entries can be submitted in on-line, or in batches. Series Ƶ also provides for on-line inquiry to the data base, at any time.

Screen Generation/ Modification

Series Ƶ permits you to build your own screens, to meet possible user-defined needs not already addressed by the system.

On-line Help

On-line help features include diagnostic, data definition and screen help. Series Ƶ is designed with such on-line features to assist the user or operator in learning how to use the system faster without the need to consult a manual or leave the terminal.

Software Maintenance

An important aspect of any software purchase is the availability of maintenance. Series Ƶ has a complete maintenance program for regulatory changes and/or enhancements.

Series Ƶ Report Writer

Report Writer capability is available to address generalized user-defined needs. Series Ƶ system architecture facilitates easy access by a variety of report writer software.

A Leader in Information Services

Our capabilities are backed by a staff of more than 150 professionals who concentrate on every element of each customer's individual requirements.

We are dedicated to seeking better solutions to turn data into useful information. We offer a full range of support services including customer training, user group participation, the necessary documentation, source code, test data, software maintenance and technical support.

Our experience and success in providing flexible, state-of-the-art systems makes us confident that Information Associates has such a system to meet your needs. For more information on Series Ƶ or other systems, computer services or products, call or write to the Information Associates' office nearest you.

Information Associates

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SYSTEMS, INC.

Corporate Headquarters
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Walnut Creek, CA 94598
(415) 939-3900

HIGHER EDUCATION'S UNIQUE HUMAN RESOURCE SYSTEM NEEDS

The Payroll/Personnel Administrator of a college or university has information and processing requirements for employee records that differ greatly from those of other types of organizations. In addition to special governmental reporting, higher education institutions have unique pay calculation and benefit plan processes. Tenure tracking and faculty record keeping must be accomodated as well as a fluid student employee work force. The basic definition of employees positions is much more complex than in other types of institutions due to factors such as split assignments, multiple funding sources, deferred payment periods, and the monitoring of contracts and grants.

The ISI Human Resource System is unique among the available software packages in its ability to address the special needs of higher education institutions.

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IBM PRESENTATION

HOBO - SACRAMENTO COUNTY'S HANDS-ON BUDGET OFFICE

This online system can provide:

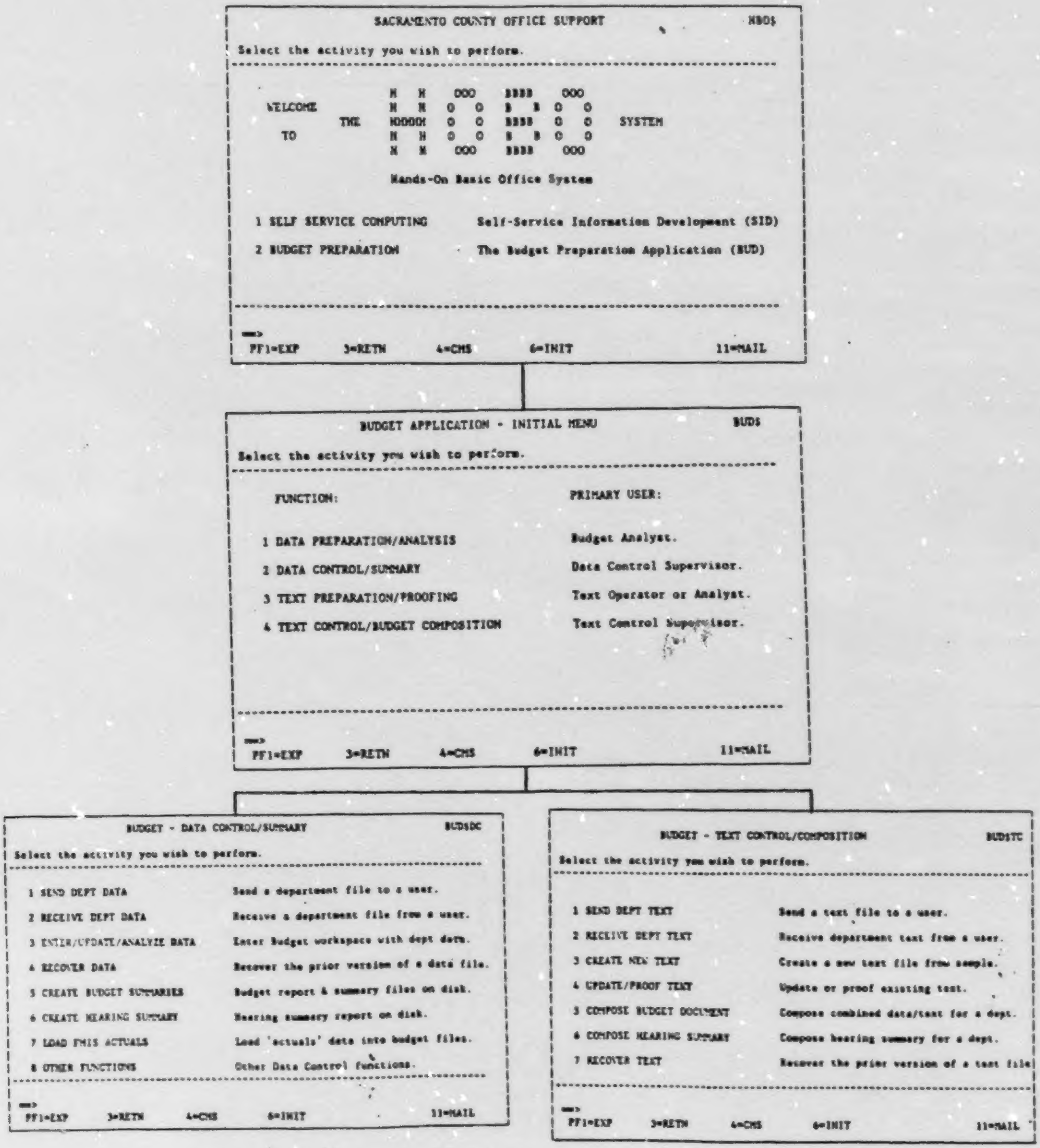
- Online Departmental Financial History Analysis
- Online Salary Analysis [1]
- Online Departmental Budget Request Development
- Online Text Preparation & Modification
- Budget Office History Analysis
- Graphic Presentation of Executive Recommendations
- Online Entry of Final Changes (Data & Text)
- Automatic Merge of Text & Data
- "Camera Ready" Document Preparation
- Line Item Fiscal Year Analysis
- Budget Tracking & Analysis [2]

It is implemented using the following IBM products:

- A Departmental Reporting System (ADRS)
- Document Composition Facility (DCF)
- Interactive Productivity Facility (IPF)
- Conversational Monitor System (CMS)

[1 & 2] Developed by IBM Public Sector Industry Marketing
Other functions developed by Sacramento County.

These menu panels show a list of functions provided by the system as it is implemented at Sacramento County:



```
                  SACRAMENTO COUNTY OFFICE SUPPORT                 HBOS
Select the activity you wish to perform.
-----------------------------------------------------------------------

                       H   H    OOO    BBBB    OOO
    WELCOME            H   H   O   O   B   B  O   O
                THE    HHHHH   O   O   BBBB   O   O    SYSTEM
      TO               H   H   O   O   B   B  O   O
                       H   H    OOO    BBBB    OOO

                       Hands-On Basic Office System

  1 SELF SERVICE COMPUTING     Self-Service Information Development (SID)

  2 BUDGET PREPARATION         The Budget Preparation Application (BUD)

-----------------------------------------------------------------------
==>
 PF1=EXP     3=RETN     4=CMS     6=INIT                   11=MAIL
```

```
              BUDGET APPLICATION - INITIAL MENU                    BUDS
Select the activity you wish to perform.
-----------------------------------------------------------------------

   FUNCTION:                                PRIMARY USER:

  1 DATA PREPARATION/ANALYSIS               Budget Analyst.

  2 DATA CONTROL/SUMMARY                    Data Control Supervisor.

  3 TEXT PREPARATION/PROOFING               Text Operator or Analyst.

  4 TEXT CONTROL/BUDGET COMPOSITION         Text Control Supervisor.

-----------------------------------------------------------------------
==>
 PF1=EXP     3=RETN     4=CMS     6=INIT                   11=MAIL
```

```
              BUDGET - DATA CONTROL/SUMMARY                      BUDSDC
Select the activity you wish to perform.
-----------------------------------------------------------------------
  1 SEND DEPT DATA                Send a department file to a user.
  2 RECEIVE DEPT DATA             Receive a department file from a user.
  3 ENTER/UPDATE/ANALYZE DATA     Enter Budget workspace with dept data.
  4 RECOVER DATA                  Recover the prior version of a data file.
  5 CREATE BUDGET SUMMARIES       Budget report & summary files on disk.
  6 CREATE HEARING SUMMARY        Hearing summary report on disk.
  7 LOAD FMIS ACTUALS             Load 'actuals' data into budget files.
  8 OTHER FUNCTIONS               Other Data Control functions.
-----------------------------------------------------------------------
==>
 PF1=EXP     3=RETN     4=CMS     6=INIT                   11=MAIL
```

```
              BUDGET - TEXT CONTROL/COMPOSITION                  BUDSTC
Select the activity you wish to perform.
-----------------------------------------------------------------------

  1 SEND DEPT TEXT                Send a text file to a user.
  2 RECEIVE DEPT TEXT             Receive department text from a user.
  3 CREATE NEW TEXT               Create a new text file from sample.
  4 UPDATE/PROOF TEXT             Update or proof existing text.
  5 COMPOSE BUDGET DOCUMENT       Compose combined data/text for a dept.
  6 COMPOSE HEARING SUMMARY       Compose hearing summary for a dept.
  7 RECOVER TEXT                  Recover the prior version of a text file
-----------------------------------------------------------------------
==>
 PF1=EXP     3=RETN     4=CMS     6=INIT                   11=MAIL
```

For further information contact Mr. D.J.(Doug) Aldridge, IBM Corporation, Public Sector Industry Marketing, 10401 Fernwood Road, Bethesda, MD 20817, (301) 897-2613.

BEST COPY AVAILABLE

STRUCTURED RETROFIT

Structured Retrofit applies software tools to convert existing, unmaintainable COBOL software to a structured and improved form that is more readable, more easily understood, better organized, and better documented than the original. This process improves the condition of old, undocumented, and frequently patched application software, at significantly less cost than replacement of existing applications software would require. It also generates more reliable systems than the implementation of new software packages.

Producing computer software is an expensive and time-consuming process; existing software is an enormous asset that already embodies the many characteristics of the university that would be costly and impractical to develop again. Such characteristics as organizational structure calculations, and an endless list of other examples are embedded in current application systems. As a result, institutions prefer maintaining existing software to undertaking a major overhaul of their information systems.

However, much of this software is very expensive to maintain and upgrade. It may have sustained many changes and enhancements over time to the point where the logic is difficult to follow. Often 70% or more of the standard MIS systems development budget is spent on maintaining old software. This is an expense that could be dramatically reduced if the logic of the program could be made easier to follow.

Structured Retrofit uses a software engine to examine existing source COBOL software and revise the program to eliminate nonexecutable code, "fall-through" logic, and outdated statements and to isolate input/output instructions. The process also splits overly large programs into more manageable size, and incorporates standard names for data throughout the application system. In addition, the engine standardizes the software so that it is easily read, understood, modified, and conforms to the institutions' desired structural software standards. The bulk of this process is automated, although some manual resolution may be required. Extensive testing of the new version of the software is performed as a part of the retrofit. Final acceptance of the new version of the program is based on generating output that is 100% identical to the original system.

Structured Retrofit is used to achieve two major objectives:

1. To structure, standardize and format existing code so that it is easier to maintain. This saves considerable time and is dependent on fewer key analyst/programmer personnel. Substantial reductions in maintenance programming costs will be achieved and more comprehensive enhancements can be undertaken.

2. To allow existing applications to be migrated to a new hardware, database or distributed environment by structuring the programs and isolating the technology related modules. This greatly reduces the burden of conversion and allows the organization to focus upon only what will change.

The advantages of Structured Retfofit to a university are reduction in maintenance programming costs and the savings of time and money over rewriting or replacing existing software. Typically, the cost of a retrofit is half that of implementing new software, even when new features and capabilities are desired, and it can be accomplished in approximately one-third the time.

Once a solid foundation is put in place through the Retrofit process it is possible to implement a data dictionary and a data base capability that enables an organization to convert existing systems to an on-line data base or data communications system. Finally, retrofitted software can be maintained by junior-level porgrammers, freeing the more experienced staff for other custom development assignments.

Structured Retrofit is an exciting new approach to systems maintenance. This product is available through Peat, Marwick, Mitchell & Co. Structured Retrofit is primarily for software written in COBOL. Generally, retrofit is performed on IBM hardware, although non-IBM hardware environments can also be accommodated.

For more information: Peat, Marwick, Mitchell & Co.
345 Park Avenue
New York, New York 10154

ADMINISTRATIVE COMPUTING IN A USER-FRIENDLY ENVIRONMENT THROUGH MICRO COMPUTING

SYSTEMS & COMPUTER TECHNOLOGY (SCT) CORPORATION

Administrators in higher education nationwide are faced with the problem of developing effective strategies relative to the acquisition and utilization of micro computers. With the cost of micros decreasing and their availability increasing, it is imperative that administrators develop appropriate plans designed to ensure proper and effective use. Specifically, an institutional strategy is required to 1) evaluate the technology acquired and ensure its usefulness for the future; 2) guarantee that configurations are acquired to meet stated goals and achieve specific results; and 3) ensure that hardware and software acquisitions will merge into a larger, more efficient computing environment.

Dramatic progress has been made in the size, capacity and cost of micro computers. Their seemingly universal use has been possible due largely to advances in integrated chip technology and to the widespread distribution and service networks which have developed around the newer technology. These networks have made it possible to utilize sophisticated data retrieval services without concern for mainframe or programmer involvement. Similarly, major advances have also been made in software and communications technology required to link micro computers. The advent of the local area network (LAN) concept (the functional ability to link many micros together in a data sharing environment), coupled with a greater availability of synchronous software and communications devices, and the increasing use of commercial information networks have contributed to increased usage of the personal computer.

Assessing the "correct" decision relative to micro computing acquisition and utilization often involves determining which firms will remain viable entities in the market over the next three to five years. Most market analysts agree that the present "glut" of competition in the micro/PC industry will soon create a market "shake-out" which will impact a number of high technology firms. In most cases, IBM, Apple, DEC, Wang, and Hewlett-Packard are consistently identified as firms likely to survive any shake-out and dominate the marketplace.

Growing demand for more "user-friendly" computing technology and information management has also enhanced the appeal of micro computers. Traditional systems development procedures have not kept pace with user's needs and have often resulted in a high degree of frustration for computer users. And while a variety of mainframe productivity tools have been introduced, none has achieved the levels of responsiveness currently available with some micro/PC management analysis and decision-making tools.

There is growing enthusiasm today for the potential of local area networks. These LAN's promise easy linkage of micro computers and thus facilitate the sharing of data among various application points. It is only through such network sharing that one can visualize micro computers replacing the functional capacities of mainframes running integrated, data base-oriented systems. Since no one wants to return to the manual "nightmares" which existed in the error correction cycles of batch systems or the inaccuracies or lack of compatability in separate and independent systems, effective use of micro computers must include strategies for "synchronizing" data from one functional area to another.

There is considerable software available for use in the micro computing environment, yet a fair amount of this is being developed by small "backroom/garage" companies which have only been in business a very short time. Typically, they have minimal cash funding and no proven track record for software reliability, maintenance or functional adequacy. Frequently, the software cannot be reviewed prior to purchase and calls for assistance with a "software problem" often go unanswered.

Another major consideration in creating appropriate strategies for micro computing use relates to the increasing costs of personnel. It is well documented that the overall costs of data processing, resulting from decreasing hardware costs, is now at an end. This is largely due to the rising costs of personnel recruitment and retention. Where once computing was centralized to reduce operational costs, the centralization of program development and maintenance is now an important consideration. This is due to increasing costs of attracting personnel, the need for providing appropriate career paths, and the need for extensive training to keep data processing skills current.

The widespread use of micros carries large hidden costs. For example, costs are incurred when "key professional and managerial employees are lost for a week, two weeks, or a month as they disappear and master their personal computers." Furthermore, "the $3,000 purchase price will quickly double as the organization adds equipment (another diskette reader, a better printer, more memory) and buys software--lots and lots of software." [1]

It is important that administrators creating strategies for micro computing also be aware of changing technologies. SCT is involved in the mainstream of state-of-the-art technology and, as such, continuously reviews the latest in data base technology, program or productivity aids, hardware futures, and operating systems trends. From this involvement, SCT understands that data base technology is a major ingredient both within the micro and mainframe arenas. It is our projection that the trend of applications software driving the computing world will continue. In short, great care should be taken in using available applications software for payroll, financial applications, and student record-keeping, etc.

Specifically, we anticipate both larger micro and mainframe computers. The projections we analyze lead us to believe that many computers will become obsolete by the converging capacity and power of the micro and the increasing capacity and power of the mainframe. SCT's analyses indicate that data base technology will continue to become more responsive and user-friendly. Further, we see the major data base software vendors investing significant dollars in research to bring the data base closer to the user, integrating it more thoroughly into the hardware for increased efficiency.

As a result of these technological projections, SCT recommends a strategic approach to planning and utilization. Specifically, we recommend our clients continue to use, for the most part, centralized mainframes for their larger applications which require integration and interactive access. For financial, student, and payroll/personnel systems, we recommend continued use of the data base and programmer productivity environment available on the mainframe. However, to move toward the future and to enhance the usability of the data residing on the mainframe, we recommend users look toward the integration of micro computers with their mainframe host. To facilitate this, SCT has developed products which provide a pathway from the micro computer into the functional data base. This access pathway goes well beyond conventional packages and, in fact, is integrated both with the application and with the data base manager resident with the functional application. Most importantly, in the future users will depend on systems that have been proven in multiple institutions (for many years) and have benefited from revisions and functional enhancements.

The problem of synchronization (or data concurrency) is another key aspect of SCT's approach. Specifically, what is done by a distributed user should be reflected back in the main data base as soon as possible so other users have the same information available to them. When data gets out of "synch," various functional areas then look at different views of reality for the same data element. The most meaningful answer today is to use software that emulates synchronous terminals, thus allowing a user to look both like a "distributed center" and an on-line user (with both input and output capabilities).

These strategies provide two advantages: 1) they accommodate the fact that mainframes are declining in cost; and 2) the major manufacturers are providing more and more productivity tools, thus meeting the demand to decrease the time and energy required to develop systems. These are fast becoming critical strategies in light of the fact that computing is becoming more important for the nation's productivity.

The U.S. workforce is currently estimated at 100,000,000, of which 65,000,000 are considered "white collar." By 1990, it is predicted there will be one work station per telephone for each white collar worker. Today, the amount of business data is doubling every 10 years, while historically the workforce grows at 1% per year. At that rate, it follows that in 10 years there will be twice the amount of work but only 10% more people to do it. If, as it has been estimated, it costs $8.00 to maintain a line of code and if the average network by the end of the decade contains 500 terminals, we must continue to improve our productivity and creativity to meet these demands. It is clear that if the micro computing industry meets its projections, sophisticated work stations will be available for under $1,000 by the end of the decade.

SCT's strategy is to recognize the existence and dominance of both technologies and provide environments that integrate the best capabilities of the micro computer with those of the mainframe.

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[1] "An Unmanaged Computer System Can Stop You Dead," Brandt Allen, *Harvard Business Review* (November, 1982).

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WANG

DBMS FOR THE WANG VS COMPUTER

BY

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The Wang VS computer is a remarkable machine, but until recently it has been perceived as only an office automation machine. But, for those in the education environment who also need a computer for their data processing needs, the VS now offers a full range of data base management tools that make it a powerful and versatile processor of data.

At the low end, VS Alliance is an OA DBMS that controls and integrates word processing, data processing, audio processing and networking on the VS. It is the tool provided for handling unstructured data typical of the office automation environment.

PACE (Professional Application Creation Environment), which is scheduled for general release in June of 1984, is the DBMS solution geared for the traditional user of the VS who needs and expects ease of use when faced with the task of building an application that requires data entry, data maintenance, query and report writing capabilities. PACE is composed of RDMS, a relational data base management system; Application Builder, a non-procedural tool for quickly building the simpler applications in question; Query and Report, for retrieving and displaying information controlled by RDMS; VS Graphics, for displaying data in graphic form; and, Dictionary that controls all the components mentioned above.

The high end DMBS solution geared for the serious user of the VS is provided by Cincom Systems, Inc. in cooperation with Wang Laboratories. For demanding applications with large, dynamically changing bases of data and intensive multi-user activity such as Registrar Systems, Wang VS TOTAL provides the traditional strengths of a true DBMS by combining the full mainframe functionality of Cincom's TOTAL with a highly interactive, user-friendly interface in the best Wang tradition. These strengths include data independence, data non-redundancy, data relatibility, data security and recoverability in case of system failure, environmental independence and high performance. In addition, VS TOTAL comes with a full set of DBA utilities for monitoring and maintaining TOTAL files. The Interactive Data Base Generation facility, unique to VS TOTAL, makes it easy to create and maintain the descriptions of TOTAL data bases eliminating the need to learn the traditional Data Definition Language common to most data base management systems.

VS T-ASK is the on-line retrieval/report writer that enables users to extract and format data maintained in TOTAL data base files and related DMS files. Its interpretive, directory-driven operation and powerful, yet easily-used English-like command sytax lets both end-users and DP personnel access data quickly and directly. Retrieved data can also be saved in a conventional file for further manipulation by either T-ASK or the VS utilities such as VS REPORT or VS GRAPHICS.

This DBMS package combining speed, responsiveness and efficiency for true economy in data management and data retrieval is already being used by over 70 organizations around the world including several universities and colleges.

Cincom Systems is currently enhancing this DBMS package for Wang Labs by adding these additional capabilities:

1) Consolidated/In-Line Directory to control and to integrate all current and future system components. It will have a passive dictionary capability.

2) Task Level Recovery which is the most sophisticated recovery/restart facility possible is vital for certain heavily used operational control systems.

3) Index Support which will enable users to build indexes against TOTAL files to facilitate generic, partial and multi-key searches.

4) VS MANTIS, a true 4th generation application development tool, which will enable Wang users to quickly build complex, on-line application systems for use on the VS or on a production IBM mainframe that has IBM Mantis running.

With one additional component, Logical User View, to be added in the next development phase, Cincom Systems DBMS Solution Package for the Wang VS will be the next generation of integrated data base technology providing its users with complete system integration, data structure independence, in-line directory control providing true distributed data base processing across a mix of hardware lines, standard file support for all DBMS tools and most importantly a clear growth path to new hardware and software technology.

SUITE EXHIBITS

CAUSE 83 included a number of Suite Exhibits set up by companies to display and/or demonstrate products. The photos on these two pages were taken in the suites during the Vendor Hospitality evening.

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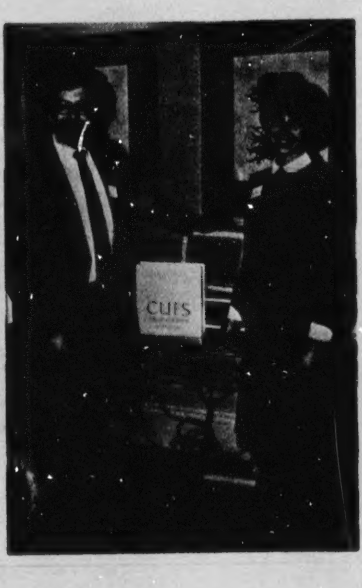


TEXAS INSTRUMENTS

BUSINESS AND PLEASURE

Ideas are exchanged as readily during breaks between sessions as they are at formal track presentations. An important part of the Conference experience are the social gatherings—those that are scheduled as official Conference activities as well as those that occur spontaneously as new friendships are formed and old acquaintances renewed.

REGISTRATION RECEPTION

Special thanks to Digital Equipment Corporation (DEC) and Electronic Data Systems Corporation (EDS) for their sponsorship of the CAUSE 83 Registration Reception.

REFRESHMENTS

Special thanks to Digital Equipment Corporation (DEC), Integral Systems, Incorporated (ISI), and Midwest Systems Group for their sponsorship of refreshment breaks. DEC also provided coffee mugs to all conferees, commemorating CAUSE 83.

BREAKS

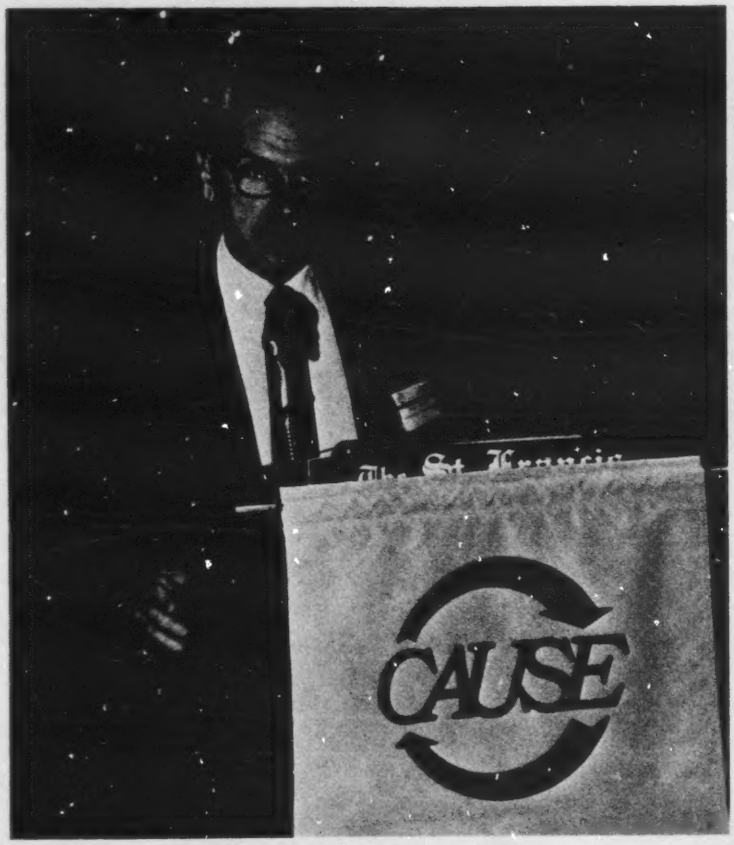
"A SAN FRANCISCO SCENE"

Special thanks for their sponsorship of "A San Francisco Scene" to: Digital Equipment Corporation (DEC); IBM Corporation; Peat, Marwick, Mitchell & Co.; and Systems & Computer Technology Corporation (SCT).

Happy Birthday, Jim!
President Strom celebrated a landmark birthday with a landslide attendance of 500 guests.

CAUSE 83

Not Registered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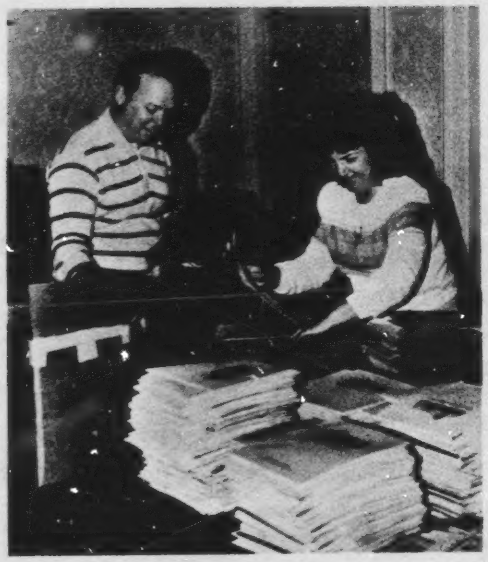

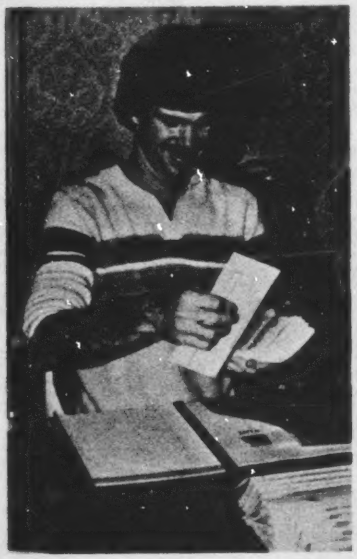

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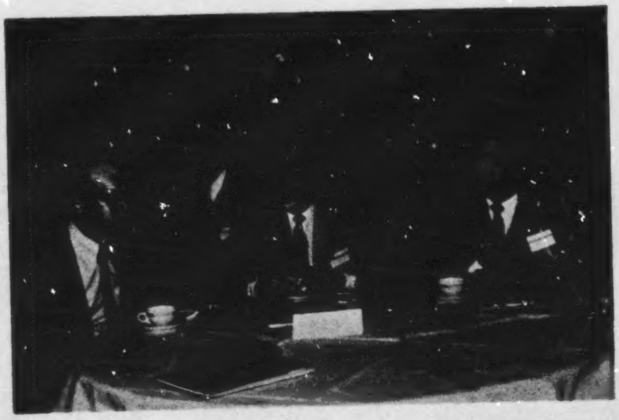

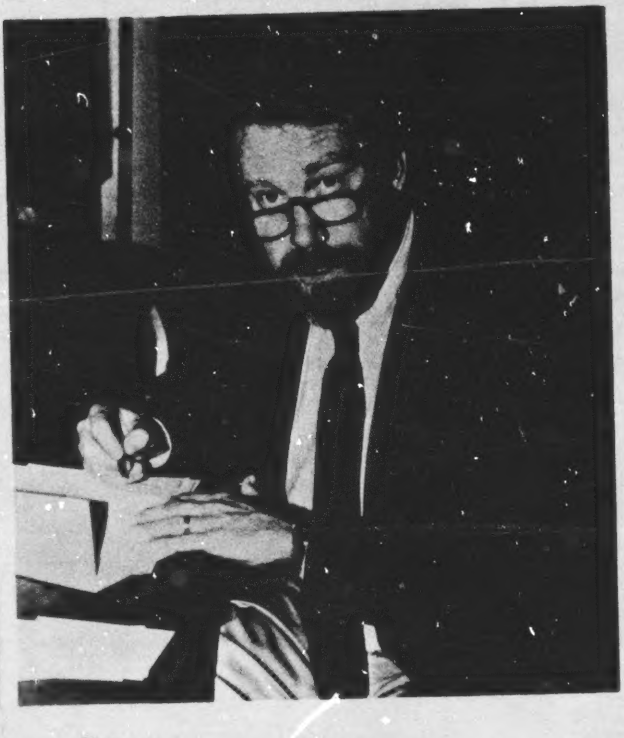

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